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GRADE TWO MELODY RECOGNITION AND CONSERVATION

by



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A THESIS

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The undersigned certify that they have read, and
recommend to the Faculty of Graduate Studies for acceptance,
a thesis entitled, "Grade Two Melody Recognition and Conservation,"
submitted by Warner William Davidson, in partial fulfilment of
the requirements for the degree of Master of Education.

ABSTRACT

The purpose of this study was to (1) investigate the possibility that a significant relationship exists between the grade two child's ability to conserve a familiar melody and his ability to conserve in five selected areas of mathematics, and (2) identify the deformations that are the most difficult to overcome when a child in this age group attempts to conserve melody.

A Conservation Test and a Conservation of Melody Test were developed by the researcher from previous studies. Both tests contained ten questions.

The tests were individually administered to a sample of eighty grade two children selected randomly from the Public School System in Regina, Saskatchewan, Canada. This sample, comprised of thirty-nine boys and forty-one girls, ranged in age from 7.5 to 9.7 years.

The relationships between variables were determined by computer analysis using Multiple Linear Regression Analysis and the Pearson Product Moment Correlations program.

In general, the results indicate that no significant relationship exists between the child's ability to conserve quantity, number less than ten, number greater than ten, length, and area, and his ability to conserve a melody that had been transformed in various ways. With respect to the conservation of melody, it was found that the three areas in which grade two children have the most difficulty involve meter transformations, variations, and polyphony.

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CHAPTER I

INTRODUCTION

The schools should produce intelligent consumers of musical goods and services. That is, we want our graduates to be able to select and purchase quality musical instruments, recordings and equipment; to help bring good professional artists to perform in their communities; to display some selectivity in their support of local musical activities; and at least to "turn the dial" with some informed purpose. (House in Henry, 1958, p. 243)

Everyone, in some way, is a consumer of music. This is because more and more music surrounds us in our daily lives. The development of the long playing recording and the magnetic tape have resulted in a greater variety of types of music becoming available. The invention of the transistor radio has meant that today one can take music practically anywhere with him. Music surrounds us not only in the home, in the theatre, and at the concert hall, but often in shopping centers, elevators, restaurants, air terminals, and food markets as well. It is a standard cliché to suggest that changes in our standard of living and our increased leisure time have been important factors in the increased consumption of music.

In the development of intelligent consumers of music, formal listening experiences in school should play a key role. One of the important goals of the music education program should be to help the child become more discriminating and sophisticated with respect to musical materials and musical forms. This involves the mastery of specific listening skills that enable the child to apprehend the expressive aspects of music. Listening activities should provide these

consumers of music with a foundation for informed and objective judgments regarding quality by enhancing their understanding of the art.

Music education has come a long way in North America, particularly during the last forty years, in finding a place for itself in the public school curriculum. Unfortunately, however, the emphasis of the music program has tended to center around the child as a potential performer. The trend has been to select students who have exhibited certain capabilities in the performance area, and to provide opportunities for this group at the expense of attention to the musical requirements of the student population as a whole. It has been estimated that approximately eighty-five percent of the students in Canadian high schools are being neglected as a result of this procedure. Because music educators have failed to grasp the concept of the child as a potential consumer of music, there has been too little effort in the listening area, and listening skills in the great majority of the school population have as yet not been developed.

In order to overcome this difficulty, listening experiences that have meaning for each child must be developed. This important area of music education cannot continue to be overlooked.

Listening, when properly guided and focused upon the musical content of a composition, can be a most effective means of musical understandings and insights.
(Hartshorn in Henry, 1958, p. 265)

Statement of the Problem

The development of meaningful listening experiences requires that music educators acquaint themselves with the developmental needs of the child. Curriculum research, and studies of child development must

form the basis for further program development. Experimental research is needed in most areas of music education, but most particularly in the field of human intellectual growth and its relation to the development of musical understanding. In an effort to gain further insight into these questions, research in other areas of education is being examined by musicologists to determine whether some of the findings might prove to have relevance when applied to the field of music education. In certain areas such as mathematics and reading, much research has been conducted in child intellectual growth, and the theories developed by some of the investigators in these other areas of educational research may be broad enough in scope to apply as well to the development of the child's musical understanding.

Of particular interest to this researcher was the work done by Jean Piaget (1952), the Swiss psychologist, in the field of child intellectual development. Piaget has developed the concept of conservation, which according to him, is a necessary condition for all rational activity. A number of tests based on this concept have been devised and used extensively in educational research.

Marilyn Zimmerman (1970), an American musicologist, has applied the mathematical or physical idea of conservation to the elements of music. She has designed tests to measure the child's capabilities in the area of music listening, and has done considerable research into child development and listening ability.

The question which this study attempted to solve was whether there is a significant relationship between the child's ability to conserve quantity, number, length, and area as outlined in Piaget's research, and the child's ability to conserve melody despite

deformations such as those introduced in Zimmerman's work. Some educators have suggested that conservation may well underly many areas of learning.

In order to answer the above question, the following hypotheses were presented:

1. There is no significant difference in scores on the Conservation of Melody Test among the six groups formed on the basis of their conservation scores, controlling for I.Q., sex, age, and socio-economic status.
2. There is no significant difference in the scores on the Conservation of Melody Test, holding I.Q., sex, age, and socio-economic status constant, between conservers and non-conservers of (a) quantity, (b) number less than 10, (c) number greater than 10, (d) length, and (e) area.
3. No significant relationship exists between the ability to conserve melody and the child's (a) I.Q., (b) chronological age, and (c) socio-economic status.
4. There is no significant difference in scores on the Conservation of Melody Test between males and females.
5. No significant correlations exist between the scores on the individual items in the Conservation Test and the individual items in the Conservation of Melody Test.

Need for the Study

If the primary aim of music education is to develop the potential for aesthetic involvement in music to its highest level, it would seem that a logical procedure to follow in order to insure that this aim is being realized would be to determine which of the methods of music instruction is coming closest to attaining this goal. (Ware, 1968, p. 7)

As a result of the lack of experimental research, the methods employed in musical instruction and the sequence of the program are still based on a great deal of supposition. The major question still facing music educators centers around how the child develops an understanding of musical concepts, and what educational methods will be most effective in helping him to become a mature consumer of music. There is no question that an aesthetic involvement with music comes about as a result of perceptive listening, and that this involves conscious thought. It involves not only distinguishing one tone from another, but the ordering of these tones into meaningful patterns. The child must develop the ability to "think sounds"--to hear them in his head when no sound is actually present.

Psychologists have identified a number of stages that children go through during their intellectual development. In order to improve the listening program, this development must be taken into consideration. Music educators must determine the relationship between the child's intellectual growth and the development of listening skills.

In order for the child to develop an increasingly critical understanding of the music he listens to, he must be able to grasp and retain in his mind the various melodies out of which it is built. Each melody contains a particular organization of tonal and rhythmic elements that is different from any other organization of these elements. If a child is capable of recognizing a melody that has been removed from its original context and altered in some way, then he is said to have the ability to conserve melody. Because music moves in time, it is only through conservation that the child can relate the

various melodies to one another and discover the organic unity within the piece. Through an understanding of the design or form of the music the child can then begin to grasp the inner content of the work and develop an aesthetic involvement with the music. The understanding of melody is in this way directly related to the understanding of musical form. The understanding of form is the goal toward which the music listening program should be directed. The child will not be able to detect form unless he has first developed the ability to conserve melody.

Until now there appears to be no research into the possibility that the concept of the child's ability to conserve in the mathematical or physical sense, as developed by Piaget, might be broad enough in scope to relate also to the child's understanding of melody. Although Zimmerman based her conservation of music tasks on the work of Piaget, she did not attempt to determine whether there was a relationship between the two types of conservation. Indeed, she suggested that in the area of rhythm there was no doubt but that a different kind of intellectual development was involved. There may be, however, a relationship between the work of Piaget and the development of understanding in the area of melody. It is hoped that this research has contributed in the search for an answer to this question.

Limitations of the Study

As with any research involving people, variables which are almost impossible to control may have some undetermined effect on the data collected and will reduce the validity of the study. It is with the above statement in mind that the subjects were selected for this

study on a random basis. The sample for this study was limited to one city in Western Canada, and to a random group of 80 grade two children from the public school system of that city. It is assumed that the music education program in the primary grades is representative of the of the program found in other urban centers. It may be that the children selected are either above or below some hypothetical norm of development. It is also assumed that the sample that has been tested is representative only of urban children. As the age of the sample centers around 8.16 years, any relationships which may have been found apply at most to the particular age group of the study.

Definition of Terms

Conservation: is defined as the logical understanding that properties of an object are conserved when those properties remain invariant although the object undergoes a transformation.

Conservation of melody: is defined as the logical understanding that melodic identity is maintained despite deformations and/or removal of irrelevant musical elements. It is the ability of an individual to retain the idea of sameness with regard to melody despite deformations and/or removal of irrelevant aspects of that melody.

Relevant aspects of melody: are defined as its tonal configuration and its melodic rhythm pattern.

Elements of music: are defined as tempo, mode, harmony, pitch, dynamics, instrumentation or tone color, rhythm and form.

Attainment of the concept of conservation: was evaluated on the basis of the child's performance on the Conservation Test.

Attainment of the concept of conservation of melody: was

evaluated on the basis of the child's performance on the Conservation of Melody Test.

Significance of the Study

Only as music educators examine the role of the intellectual processes in musical learning will they be able to select and organize valid musical experiences that truly facilitate musical learning. (Pfleiderer, 1967, p. 223)

It is suggested that this study may have the following educational implications:

1. In determining what proportion of grade two children are capable of conservation of melody, and to what extent the specific deformations interfere with the child's ability to perform various conservation tasks, it may be possible to make certain judgments as to the relevance of certain types of listening activities at the grade two level.
2. If a significant relationship does exist between the child's ability to conserve in any or all items on the Conservation Test, and his ability to conserve melody, then the teacher could readily determine whether the child was capable of conservation of melody through the administration of a conservation test. The listening program could then be based on accurate knowledge of the intellectual development of the child.
3. There has been considerable speculation that conservation may be enhanced by special instruction. Research is presently underway to test the validity of this speculation (Zimmerman, 1970). If the results of this research support the theory that children can be assisted in the development of the decentering process,

this study might provide useful information regarding the kinds of learning that could be introduced at the grade two level.

CHAPTER II

A REVIEW OF THE RELATED LITERATURE

The purpose of this chapter is to review some of the literature which appears to have relevance to the present study. The studies mentioned are, for the most part, involved with some aspect of the conceptual development of melody. A psychological view of the nature of melody will first be discussed. The second topic focuses upon the development of musical perception in children as a fundamental response to the environment. Two important developmental theories, those of Brehmer and Bentley are outlined. Piaget's developmental theory, particularly the concept of conservation is then presented. This is followed by a summary of the research related to conservation of musical elements that has been undertaken by Zimmerman (nee: Pflederer). The last topic in chapter two is a discussion of the conservation of melody as a key to the understanding of musical form.

Melody as a Gestalt

In an effort to define some overall developmental pattern of melodic perception in the growing child, musicologists have suggested that it must relate to the nature of melody itself. A melody contains a precise and particular organization of tonal and rhythmic patterns. In order to understand a melody, one must understand its underlying unity.

A top-level principle of Gestalt psychology is involved in the interlocked statements that the whole is more than the sum of its parts; that parts derive their properties from wholes; and that the whole conditions the activities of its parts. As an example, it is maintained that the individual tones of a melody derive their position and appropriateness from the melody as a whole Thus a melody, rather than being a collection of notes and other musical notations, is a recognizable pattern or Gestalt thereof. (Wheeler, 1932, pp. 71, 74, 75)

This concept of the melody was supported by the research of Ortman (1926), who concluded that the psychological status of any tone in a melody is determined by its "tonal environment"--its placement in the pitch and time series. He found that the position of each tone was relative to the others in the phrase.

In order for a melody to be learned, its various elements must be ordered in the mind of the listener.

We must perceive the relationship of the beginning to the middle, of the middle to the end. We must apprehend the tones not singly, but as part of the melodic line, just as we apprehend words in a sentence not separately, but in relation to the thought as a whole. Heard in this way, the melody takes on clarity, direction, meaning. (Machlis, 1961, pp. 14, 15)

The importance of the memory factor in the understanding of melody was stressed by Bugg and Herpel (1946). As a result of investigations into the relationship between pitch discrimination and tonal memory, these investigators concluded that "pitch discrimination is likely to be unsatisfactory when tonal memory is markedly inferior." And it appears that tonal memory increases with age.

This extremely important point has been brought out in what appears to be by far the most important early investigations into the melodic responsiveness of children. Brehmer (1932), studied both the vocal and verbal responses of children from five to thirteen years of age. They were required to answer "same" or "different" in regard to

various phrases, some familiar, some unfamiliar and some transposed. The same procedure was carried out with certain scale patterns. Brehmer found that the child's ability to think tonally improves with age and mental maturity, and that the tonal thinking of children is dominated by the function of the musical configuration as a whole.

It has been shown that children always tend to respond to a melody as a living totality, not as a structure built out of notes. When they make mistakes in singing back a melody by ear, such mistakes are not true note-errors at all, but misapprehensions of the total melodic shape, in which it is perhaps simplified by reducing the size of the interval skips or by leaving out some fine point of nuance, or otherwise distorted. (Brehmer as reported in Mursell, 1948, p. 41)

The Development of Musical Perception

Today music educators generally think of musical perception as a developing ability in children, dependent on both heredity and environment. Just what the relationship is between these two factors is a difficult and as yet unsolved problem in music education research. Most of the work in the field has centered around such phenomena as rhythmic ability, pitch discrimination and auditory perception, and investigations into how the child forms musical concepts are not extensive.

With the goals of the public educational system in mind--learning experiences that meet the needs of all children--researchers have studied child mental development in an effort to discover what the patterns of response are, how they are developed, and to what extent they are shared among various groups. It has been known for some time that there exists among most children, a common responsiveness to the tonal and rhythmic patterns that make up music. Mursell has defined

this basic response as "musicality," and states that, "So far as we can tell, it is universal, or very nearly so, among human beings ... and appears to be one of the fundamental ways in which man responds to the dynamics of his environment." (Henry, 1958, p. 146)

Brehmer distinguished three stages in the development of tonal thinking in children. He termed these the substance stage, the action stage, and the relation stage. In the substance stage, Brehmer suggested that the child hears the tones each separately as "tone bodies," and can in no way relate one to another. As the child proceeds into the action stage, he finds it possible to follow the melody line and understand how the basic contour develops. It is in the relation stage where the subject is able to relate the various intervals with one another and within the complete tonal context. When the child has reached this stage he is able to look at the melody in a theoretical way if he finds it necessary to do so.

Arnold Bentley (1966), has also concluded that there are three basic developmental stages in the child's response to melody. Keeping both the rhythmic and tonal aspects of melody in mind, Bentley studied the responses of children during play. The three stages he termed rhythmic coalescence; grasp of the tonal configuration, more approximate than exact; and coincidence in pitch, when the exact tonal configuration is sung at the pitch of the stimulus tune. Bentley theorizes that the child approaches melody first in terms of its rhythmic aspects, then as the child develops, more and more in terms of the melodic contour and the relationship of the specific intervals to one another.

The child seems to grasp the rhythmic pattern relatively easily and in this he is helped by the rhythm of the words. The second and third stages appear to be closely associated, and pitch is

involved in each. The intervals of the vocal response to the tonal shape of a melody tend to be only approximate until they coincide at the unison; then the vocal response corresponds in all respects with the tonal configuration of the stimulus tune. (Bentley, 1966, p. 27)

The research carried out by Brehmer supports the theory that melodic perception is a developing phenomenon. Brehmer (reported in Mursell, 1937), distorted certain interval relationships of familiar melodies by altering the key. He then asked a sample of children ranging in age from seven to fourteen years to tell whether or not the melody sounded different, and if so to point out where. The seven-year-olds were not successful in locating the differences, while over 90 percent of the fourteen-year-olds located them accurately. It was concluded by Brehmer that a true key feeling (that is, an accurate understanding of the interval relationships to one another, and to the tonal center) does not develop in children until about age fourteen.

Piaget's Developmental Theory

The stages in melodic perception and tonal thinking that have been outlined by Brehmer and Bentley appear to be similar to one another, and also appear to coincide with the stages of intellectual development formulated by Piaget (1952). According to Piaget, the child passes through four major levels of cognition, the sensori-motor level, the pre-operational level, the concrete operational level, and the formal operations level. During Piaget's pre-operational stage the child reasons from particular to particular, he is unable to coordinate relationships and can deal with only one problem at a time.

From the structural point of view, the first circular reactions lack intention. As long as action is entirely determined by directly perceived sensorial images there can be no question

of intention ... one cannot infer that there is a conscious purpose. (Piaget, 1952, p. 143)

At this stage the child would be unable to coordinate tonal relationships because he would hear each tone as a separate entity. Piaget's concrete operational stage might correspond to the second stage proposed by Brehmer and Bentley. This stage features a beginning of the apprehension of tonal relationships as the child listens to a melody. It is not until the child reaches the concrete operational level (from about age seven to eleven years), that he is capable of conceptual thought and can integrate two temporally separate experiences into a single judgment.

The Concept of Conservation

At the concrete operations level of development the child begins to achieve the concept of conservation. Prior to this, his thought tends to be dominated by his perceptions. Once conservation has been attained however, he is freed from the domination of his perceptions and his thoughts become more conceptual. The child is able to deal with more complex relationships and cannot only take into account the immediate situation, but also make comparisons and explore the similarities and differences found in previous experiences. The result is that he is less prone to make errors in judgment, for he has developed a system with which he can now organize his thoughts. The child is now capable of thinking through a problem by proceeding forward or backward, and he can set aside in his mind the effects of any changes in an experience in order to focus his attention on those aspects that have remained invariant.

Piaget's idea of the reversible operation, a definitive characteristic of mature thought, is the keystone of his theory. According to Piaget, reversibility is essential to any form of mental experimentation and logical inference. The reversible operation is at the heart of the principle of conservation. Conservation refers to the invariance of a particular dimension of empirical objects throughout observed changes of state. It results from operational reversibility. Piaget views concept development in terms of conservation, marked by an increasing stability of a particular concept in the face of changes (often irrelevant), in the stimulus field. Conservation is justified by the properties of reversibility and compensation. When a child is able to return to the initial state of a given material by an inverse operation, he exhibits reversibility of thought and so affirms the conservation of that material. (Pfleiderer, 1967, p. 217)

There are generally three stages associated with the concept of conservation. During the first stage the child, dominated by his perceptions, is unable to see that invariance is maintained in spite of any deformations that have occurred. During the second stage the child vacillates between conservation and non-conservation because, although he is aware that contradictions exist, his perceptions tend to overrule his reasoning ability. When the child has reached the third stage perceptual changes do not interfere with his logical reasoning regarding the invariance of a particular dimension.

In 1968 Pfleiderer attempted to test the relevance of the concept of conservation to musical growth. She had previously formulated five "conservation type" laws that might be identified in the child's development of musical concepts, in an attempt to adapt Piaget's research to music education.

Research into this area might reveal that a type of conservation is involved in learning tonal and rhythmic patterns. Music tests that do not merely call for a qualitative judgment between tones and rhythms, but that provide for a study of conservation are needed. For only as music educators examine the role of the intellectual processes in musical learning will they be able to select and organize valid musical experiences that truly facilitate musical learning. (Pfleiderer, 1967, p. 223)

One factor in intelligence is the ability to perceive and invent relationships. We believe that musical intelligence is based not only upon the perception of the particular effects of musical relationships, but also upon an understanding of the relational processes from which they derive. This we believe to be a kind of conservation process. Hence, the essence of musical intelligence is found in the conceptual framework of rhythmic, melodic, harmonic, and formal relationships which has developed through a progressive organization of musical perceptions. (Zimmerman and Sechrest, 1968, p. 3)

The Zimmerman study was cross-sectional in nature, and found that on the conservation of music tasks required of them, third graders performed significantly better than second graders; fourth graders were significantly better than third graders; but that there was no significant superiority for fifth graders over fourth graders. Zimmerman is now in the process of determining whether conservation can be enhanced by special instruction. So far the results (Zimmerman, 1970), have not been statistically significant.

Conservation of Melody as a Key to Understanding Form

It is only through conservation of melody that the child can develop an understanding of the design or form of the music he hears, because only when he possesses this ability is he able to recognize how the composer has constructed and developed his melodic ideas. The importance of the child's understanding of musical form cannot be overestimated, because form is the overall organization of tonal and rhythmic elements in time and space. This is the way in which music is made. In form there exists a basic aesthetic principle of repetition and contrast. This basic idea can only be grasped if the listener is able to understand and recognize the patterns of sound in all their transformations.

A basic principle of musical form is repetition and contrast, which achieves both unity and variety Repetition establishes a relationship between structural elements. Contrast sets off and vitalizes this relationship. The contrasting material brings with it a heightening of tension, which is resolved by the return of the familiar material. Hence Ernst Toch's fine phrase, "form is the balance between tension and relaxation."

Form is the dwelling place of the idea, its visible shape and embodiment. In the highest art there exists the utmost unity between form and content, the two being as inseparable as are the mind and body: what is said cannot be conceived as existing apart from how it is said. This becomes apparent when we try to retell the content of a poem, a novel, or play in our own words. We become aware that the content changes when it is removed from its form. The unity of form and content is especially strong in music, where the form is molded to the idea and the idea is shaped by the form. The form helps us grasp the inner content of a musical work. At the same time it can itself be a potent source of aesthetic pleasure. (Machlis, 1961, p. 60)

Summary

It is for the reasons outlined above that music educators must recognize that the understanding of form should be the goal to which the listening program is directed. And this goal cannot be achieved unless the child is able to understand and manipulate the melodies out of which a work of music is built. It appears that until further research is completed into the nature of the child's development of the understanding of melody, music educators will not be able to improve the listening program significantly. As Piaget's studies become better known, musicologists will probably build on the pioneering work of Zimmerman in testing the implications these studies have for the development of a more meaningful music program.

CHAPTER III

DESIGN OF THE STUDY

This chapter describes and outlines the selection of the sample used in this research. It also deals with the instrumentation and includes information on the administration of the tests, controls, and the collection and treatment of the data.

Description of the Sample

The study was conducted at the grade two level of the elementary schools in one city in Western Canada. In the particular school system selected a publicly supported kindergarten program is in operation so those subjects who began their education in this system have had organized musical experiences for almost three years. A system of privately supported nursery schools is also in operation in the area, attended mainly by children from the higher socio-economic classes.

The music program at the primary level is usually taught by the classroom teacher. The program that is followed at all levels, beginning in kindergarten, is Making Music Your Own (Landeck et al., 1965). The core program as outlined in this music series must be completed in each classroom in the approximately 100 minutes per week allocated in the timetable. In addition to the music series mentioned above, teachers also have available to them the RCA Adventures in Music and the Bowmar Orchestral Library series, as well as the Threshold to Music series. None of these three series are used extensively, however.

Selection of the Subjects

The following procedure was used in the selection of subjects. First, the names of teachers were drawn by lot from the total number of grade two classrooms. Each name was then replaced after it had been drawn and recorded. After establishing which classrooms were to be involved, the individual student was chosen by assigning to him a number using the attendance register, and drawing the corresponding number from a deck of numbered cards. In this fashion 80 subjects, 39 males and 41 females, were selected from 56 grade two classrooms located in 40 elementary schools.

The ages of the subjects ranged from 7.58 to 9.67 years for males, and from 7.50 to 8.92 years for females. The average of the sample was 8.16 years. Full information regarding ages is shown in Figure 1.

Instrumentation

Two testing instruments were used in this study. The first, a conservation test adapted from the research of Reimer (1968), was based on Piaget's experiments. This test was utilized to obtain data in five areas of conservation. The second instrument was a conservation test adapted from the research of Pflederer (1964). A description of each of these tests follows.

The Conservation Test

Reimer's investigation was concerned with conservation and mathematics achievement at the grade one level. Based on the research

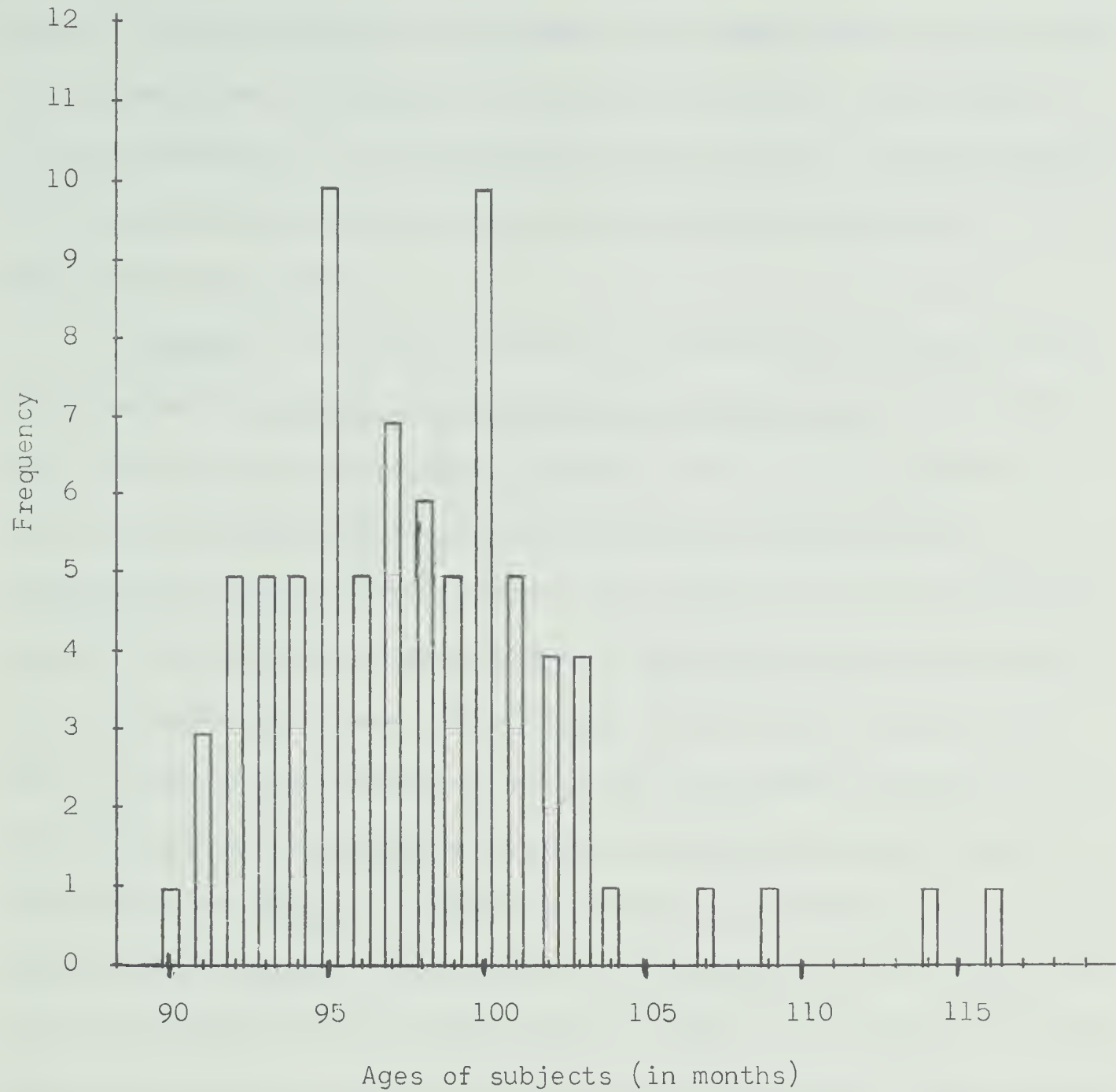


FIGURE 1
FREQUENCY DISTRIBUTION OF AGES
(N=80)

of Jean Piaget, he constructed a conservation test that included the following items; number less than ten, number greater than ten, additive arrangement of number, continuous and discontinuous quantity, and length. He found that students who scored high on this usually scored high on a mathematics achievement test.

In adapting this test the additive arrangement item was deleted

and an item concerned with area added. The conservation test used in this research was structured so that each of the five items would include two parts. In the description which follows, selected responses made by subjects will be included where necessary to make the description more clear.

Item one. The first item on the Conservation Test dealt with conservation of quantity, continuous and discontinuous. In the first part, concerned with continuous quantity, the subject was asked to examine two similar glasses, each containing an approximately identical quantity of colored water. The subject was asked whether he thought there was more colored water in one glass, more in the other, or the same quantity in both. If the subject felt that there was more water in one of the glasses, a very slight adjustment was made to the amount of water in each glass by the investigator until the subject stated that he thought the quantity of water in each glass was the same. As the subject watched, the contents of one glass were then poured into two thin containers to an equal height in both, thus emptying the glass. These two containers were then placed together about six inches from the other glass. The subject was then asked whether he thought there was more water in the glass, in the two containers, or the same in both places.

In the discontinuous quantity part of item number one the subject was asked to examine two similar glasses, each containing a quantity of rice. The quantity of rice in one glass was noticeably greater than that in the other. The subject was asked whether he thought there was more rice in one glass, more in the other, or the same amount in both. All subjects stated that there was more rice in

one of the glasses. As the subject watched, the quantity was adjusted until the subject felt that the amount in each glass was the same. The subject then observed as some of the contents of one glass was poured out onto the table before him, and the remainder poured into a tall thin vessel. The tall thin vessel was then placed about six inches from the other glass and the subject was asked whether he thought there was more rice in the glass, more in the tall thin container, or the same quantity in both.

Subjects who responded correctly to the questions in both parts of the conservation of quantity item were given a score of one. Those subjects who got either or both of the questions wrong were given a score of zero.

Item two. The second item on the conservation test dealt with the conservation of number less than ten. Seven red plastic blocks and seven white plastic blocks were used in both parts of this item. First the blocks were placed before the subject in two rows, a row of red blocks and a row of white blocks. Each block was spaced about two inches from the next, making the rows of equal length. The subject was asked whether he thought there were more red blocks, more white blocks, or the same number of both. All subjects agreed that the red and white blocks were equal in number. The subjects were allowed either to count each group, or "pair" the blocks using two fingers.

In the first part of this item, the white blocks were quickly bunched together and at the same time, one of the red blocks was removed from the end of the row. The subject was then asked whether he thought there were more red blocks, more white blocks, or the same number of both.

In the second part of the conservation of number less than ten item, the red block was replaced in the process of rearranging the rows, thus making both groups equal. The two rows were then arranged so that the spaces between the white blocks were about twice as great as the spaces between the red blocks, making the white row longer. The subject was then asked whether he thought there were more red blocks, more white ones, or the same number of both.

Subjects who responded correctly to the question in each part of this item received a score of one. All other subjects received a score of zero.

Item three. The third item on the Conservation Test dealt with conservation of number greater than ten. This item also consisted of two parts.

In the first part the subject watched while 30 beads were placed into two identical small glass containers. The beads were picked up two at a time and placed into each of the containers, one in the first one, one in the second one. The subject was told to observe the operation closely, because he would be asked whether he thought more beads had been placed in one container, more in the other, or the same number in both. Most subjects felt that there were an equal number of beads in both of the containers. Those who thought that more beads had been placed in one or other of the containers were asked to watch as the researcher counted the beads in each, thus establishing that there were 15 beads in each container. As the subject observed, the contents were poured from one container into a vessel with a very much larger diameter. This vessel was then placed about six inches from the other container and the subject was asked whether he thought there were more

beads in one container, more in the other, or the same number in both.

In the second part the subject was shown a piece of 14-inch-square white cardboard on which 12 half-inch blue squares had been mounted forming a circle with a radius of four inches from the center of the cardboard square. The blue squares were equally spaced along the circumference of the circle. Twelve half-inch yellow squares had also been pasted on the cardboard in a circle, but the radius of this circle was five-and-a-half inches from the center of the cardboard. These squares were also spaced equally along the circumference of the larger concentric circle. The subject was asked whether he thought there were more blue squares in the picture, more yellow squares, or the same number of blue and yellow squares.

Subjects who answered the questions correctly in both parts of the conservation of number greater than ten item were given a score of one. Those who did not get both answers correct were given a score of zero.

Item four. This item of the Conservation Test was concerned with the conservation of length. The apparatus used consisted of two five-inch rods, one red, the other white, constructed from "Minibricks." The white rod was built so that it could be easily reduced in length to four inches. The subject was presented with the two rods and asked whether he thought the red one was longer, or whether he thought they were both the same length. Almost all the subjects responded that they thought the two rods were the same length. To prove that they were indeed the same length, they were placed beside one another with the ends coinciding. This procedure convinced the few subjects who thought one rod was longer, that the length was the same in each case. An

inverted glass was then brought into position. The red rod was then stood on end on the table beside the inverted glass. The white rod was then shortened to four inches out of the subject's view and placed on end on top of the inverted glass. The subject was asked whether he thought that the red rod was longer, the white rod was longer, or whether they were the same length.

In the second part of the conservation of length item the white rod was restored to its original length of five inches out of the subject's view. The two rods were then placed parallel to each other on the table in front of the subject. They were positioned about an inch apart, with the white rod moved about an inch to the right so that the ends of the two rods did not coincide. The subject was told that he could not touch the rods, only look at them. He was then asked whether he thought the red rod was longer, the white one was longer, or whether he thought they were both the same length.

Subjects who answered both questions correctly received a score of one. All others received a score of zero.

Item five. The fifth item on the Conservation Test dealt with the conservation of area. The apparatus used for the first part of this item consisted of a white plastic fence, a pair of red blocks (each representing a barn), and four pairs of plastic farm animals. The fence was set up in front of the subject, dividing the table into approximately equal areas. The researcher then stood beside the subject and suggested that they play a game of farm. The subject was told that everything on the far side of the fence was the subject's farm. He was instructed to watch carefully as the researcher set up his farm. As the researcher arranged the one set of pieces, he verbalized in the

following manner:

First I'm going to set my barn up here on the right, next to the fence. Now I'm going to put my horse over here on the left by the fence, with the horse looking over at the barn. I'm going to put my pig down here (near the edge of the table), on the right and it's looking up at the barn. My goat goes over here in the middle, looking at the barn, and my chicken goes down here on the left looking the other way. Do you see how I've arranged things--the barn up near the fence and the other animals as you see them here.

The subject was then asked whether he thought he could set up his farm on the other side of the fence exactly as the researcher had done. He was then given the duplicate set of pieces and told that if he wished to come back around the table and check the other arrangement he was free to do so.

In the second part of the conservation of area item the subject was asked to return to his chair and the objects were removed from either side of the fence. On the side of the fence nearest the subject the investigator then placed two white plastic bricks parallel to each other in a position on the right beside the fence and parallel to it. He then placed two red plastic bricks parallel to one another on the left side near the fence but in a vertical position in relation to it. The subject observed this operation. As he arranged the bricks the researcher did not verbalize what he was doing. The subject was then given two red bricks and two white bricks and asked to set up the same arrangement on the other side of the fence.

Those who arranged the pieces correctly in both parts of the conservation of area item were given a score of one. All other subjects were given a score of zero.

The Conservation of Melody Test

Although any of the other elements of music could have been chosen for investigation, melody was selected because of its direct relationship to musical form. In order for a piece of music to be really understood, the listener must be aware of the architectural structure of the work. The child cannot begin to understand form unless he is first able to conserve melody, for as Mason has stated:

The aesthetic principle of repetition and contrast can be genuinely understood only when patterns of sound are recognized and understood in all their transformations.
(Mason in Zimmerman, 1970, p. 35)

The rationale. By expanding the research of Zimmerman and Sechrest (1968), the researcher constructed a Conservation of Melody Test. It consisted of ten items recorded on magnetic tape and played to the subject through a tape recorder. The rationale behind this test was that the tonal configuration and the melodic rhythm pattern are the two means by which a melody is recognized, once it has been learned by the child. In order for a melody to be conserved, these aspects of it must, for the most part remain invariant. A change in the mode or the meter deforms these identifying features, but not to the extent that a subject capable of conservation is not able to recognize that it is basically the same when he hears it a second time. The reason behind this is that by changing the mode, the tonal configuration is altered slightly in the temporally separate example, but it is not transformed beyond recognition. The same holds true with regard to the melodic rhythm pattern if the meter is changed in a subsequent example. A change in meter alters the melodic rhythm pattern but does not destroy it. Therefore a subject who is able to conserve melody should be able

to recognize the sameness of two temporally separate melodies despite a change in the meter.

Because the other musical elements do not relate directly to the two essential aspects of melody, tonal configuration and melodic rhythm pattern, a change in pitch, dynamics, tempo, accompanying harmony, or instrumentation should not prohibit the conservation of melody for those subjects who have reached the stage where they possess this ability. If the melody appears beneath an accompanying figure, or is hidden within a variation of the tonal configuration, it should be recognized by conservers of melody.

It is assumed, however, that some of the transformations used in the Conservation of Melody Test are more complex than others, and that a subject who is able to recognize the familiar melody by overcoming certain of the deformations may not be able to complete the required listening task in situations involving more complex deformations. For example, if a child is able to recognize that a melody is the same despite a change in the dynamics, will he also be able to recognize that it is the same if the melody is transposed into another key? Do children find it easier to identify transformed melodies when the meter is changed, or when the mode is altered? One of the purposes for the construction and administration of the Conservation of Melody Test was to test the assumption that for this age group some deformations may be too complex. If the ability to conserve melody is more highly developed in some members of the sample, it may be possible to arrive at an indication of the relative difficulty of the deformations used in the test. Suggestions regarding the sequence of the listening program for children of this age could be based on an indication of the success they

exhibit in overcoming the various deformations.

Selection of melodies. It was imperative that all subjects be familiar with the melodies selected for the Conservation of Melody Test. This was necessary to insure that the data obtained measured the subject's melody conservation ability, and not the speed at which the child was able to learn and remember unfamiliar music. For this reason ten melodies were selected from the core music program at the grade two level with the assistance of the Primary Music Consultant. The grade two music program is highly structured, and therefore it could be reasonably assumed that all children who had been enrolled in the school system since the beginning of the academic year would have become familiar with the ten selected songs as a result of their music program. Because she visited the grade two classrooms throughout the city frequently, the Primary Music Consultant was familiar with the relative popularity of the songs on the core program. She was asked to select the ten songs that she thought the children liked to sing best, for it was assumed that the more popular a song was, the more familiar it would be to the child. To further insure that these songs would be familiar to each subject, a list of the selected material was sent out to the teacher of each classroom from which the sample was to be chosen, four weeks before the administration of the test and the teacher was asked to review the songs with the class.

Melodies to be used as foils were selected from a grade four music text by the researcher. Care was taken to utilize only melodies that the researcher was reasonably confident would be totally unfamiliar to grade two children.

The pilot study. After the Conservation of Melody Test had

been constructed a pilot study was conducted to determine its effectiveness. Originally each of the ten items of the test consisted of the familiar melody followed by three unknowns, one of which was the familiar phrase in its distorted form, the other two being unfamiliar melodies. The pilot study revealed that the subjects usually found it very easy to identify the distorted familiar phrase because the two unfamiliar melodies were so obviously different. As a result, a fourth unknown was added to each item and randomly placed into each group of unknowns. These unknowns were derived from the familiar melody in each of the items. In every case it began exactly the same way, but in the first five items the melodic contour of this additional unknown was radically altered about half-way through the phrase. The additional unknowns placed into items six to ten were also derived from the distorted version of the familiar melody used in each item. These unknowns also began in the same way the distorted phrase did, but about half-way through the phrase the melodic rhythm pattern was radically changed. These changes resulted in the development of a completely different phrase, forcing the subject to listen through to the end of each of the unknowns before deciding what the correct response should be. Also, because two of the unknowns began in exactly the same way, he had to be much more discriminating with regard to the selection of the phrase he considered to be "most like" the familiar melody.

General format. There were ten items on the Conservation of Melody Test. Each followed the same general format. The subject first heard the beginning phrase of a familiar melody on the tape recorder and was asked to identify it during the ten second pause that followed. Four "unknown" melodies were then heard and the subject was asked to

identify the one that sounded most like the familiar melody he had heard at the beginning. The piano was the instrument heard in all the items, with the exception of item ten, where the familiar melody was played on the piano, and the unknowns were played on the tenor recorder. In all items the familiar melody was heard as single notes. The deformation involved in each item of the test was performed on all four of the unknowns. For example, if the deformation was major to minor mode, the familiar melody would be in the major mode and all the unknowns would be in the parallel minor. Each of the four unknowns was identified by number by a voice on the tape during the eight second pause that occurred between them. In each item, the musical elements involved, with the exception of the one that was distorted, were held constant. At the end of each item there was a 15 second pause during which the subject was asked to identify the unknown that sounded most like the familiar melody. The ordering of the distortions dealt with, and the ordering of the unknowns, was done randomly. The total time of the test, including the introduction, was 18 minutes.

Introduction. In order to acquaint the subject with the nature of the Conservation of Melody Test, it was preceded by an introductory item. Prior to the playing of this portion of the tape, the subject was told that this was a test to find out how well he could remember songs. He was told he would hear a song, then he would be asked the song's name. He must try to remember the song, because four other songs would be played, and he must indicate which one of them sounded most like the one he heard to begin with. It was suggested that he had probably sung

Voice: "The third one."

Piano:



Voice: "The fourth one."

Piano:



At the end of the fourth unknown the tape recorder was stopped. The subject was asked which of the four he had selected as the one that sounded most like the familiar melody. All subjects chose number four. The subject was then shown how to keep track of the four unknowns on his fingers so that he could easily remember the number of the one he had selected. He was asked to sit back and relax, and the tape recorder was started again.

Item one. Item one of the test dealt with pitch distortion.

The system used in altering the pitch was to transpose the phrase two octaves up. The subject first heard the familiar melody, the first eight measures of "Good-by, Old Paint," played as single notes on the piano. The phrase began with octave D above Middle C. Unknown number one was 12 measures of the song "Rarakatom." It began on D three octaves above Middle C. Unknown two was the first eight measures of "Give Me a Song to Sing," which began on B^b three octaves above Middle C. Unknown number three was the familiar melody played two octaves above the pitch at which it had originally been heard. Unknown number four began

exactly like unknown number three, however, beginning in measure number five the pitch of each note was lowered one tone, thus destroying the original contour of the phrase. All of the unknowns appeared as single notes on the piano.

Item two. The distortion carried out in item two was to alter the dynamics. The method used in distorting the dynamics was to change them from mezzo forte in the familiar melody to fortissimo in the unknowns. The subject first heard the first four measures of "In the Barnyard" played as single notes on the piano, mf. Unknown number one was the first four measures of "The Goat." Unknown number two was the familiar phrase played with the increase in dynamics. Unknown number three began exactly like unknown number two, however in measure three the melodic contour was reversed in all the eighth note figures, thus destroying the tonal configuration of the familiar phrase. Unknown number four consisted of the first four measures of "My Aunt Jane."

Item three. In item three the tonal configuration of the melody was hidden. The strategy used in hiding the melody was to construct a sixteenth note variation on the phrase. The tonic note of the chord on which the melody was built appeared regularly, filling in where longer valued notes had appeared in the familiar phrase. The subject first heard the first eight measures of the familiar melody "Sandy Land." Unknown number one began like the distorted version of "Sandy Land," however in measure three the tonal configuration moved upward instead of downward. In measure four the melody was centered on E rather than G, and again in measure seven the contour of the melody moved upward instead of downward. The tonal configuration of the familiar melody was destroyed in this way. Unknown number two was the

first eight measures of the familiar melody "Sandy Land" in its variation form. Unknown number three was four measures of an eighth note variation on "The Little Barn Owl." Unknown number four was an eighth note variation on "Ezekiel Saw the Wheel," four measures in length.

Item four. The tempo was changed in item number four. All other musical elements involved remained constant throughout. The subject first listened to four measures of the familiar melody "Cotton Needs Picking," played at ♩ = 96. Unknown number one was four measures of "La Calle Ancha," played at ♩ = 192. Unknown number two was four measures of "San Sereni," played at ♩ = 192. The familiar melody played at ♩ = 192 appeared as unknown number three. Unknown number four started out exactly the same way as unknown number three, and at the same speed. The tonal configuration of the familiar phrase was destroyed, beginning in measure three by raising the melody a third.

Item five. In item five of the Conservation of Melody Test the musical element harmony was distorted. The way this was done was to accompany each of the unknowns with a harmony pitched up a fourth from the correct key center. The subject heard the first eight measures of the familiar melody "Clap Your Hands" as single notes on the piano. Unknown number one was four measures of "The Keeper" with the distorted accompaniment. Unknown number two was the familiar phrase with the distorted accompaniment. Unknown number three began like unknown number two, but beginning in measure number four a different melody line was introduced, thus destroying the tonal configuration of the familiar phrase. Unknown number four was eleven measures of "Who'll Buy My Fruit."

Item six. The meter was distorted in item number six. The familiar melody heard in this item moved in duple time. All of the

unknowns except number three were written so they moved in triple time. The subject first heard eight measures of the familiar melody "On the Bridge to Avignon." Unknown number one was the familiar melody with the changed meter. Unknown number two was eight measures of "Chicago Street Cries." Unknown number three began exactly like unknown number one, but beginning in measure three the melodic rhythm pattern was destroyed by changing the meter sign in the following measures to 2/4, 4/4, 2/4, and 6/4 and changing the note values in each measure accordingly. Unknown number four was four measures of "For Health and Strength."

Item seven. In item number seven of the test the mode was distorted. The familiar phrase was heard in the major mode. All of the unknowns were heard in the natural minor mode. First the subject heard the beginning eight measures of the familiar melody "Paper of Pins" in G Major. Unknown number one was the familiar phrase in G Minor. Unknown number two was the first ten measures of "St. Lucia's Day" in G Minor. Unknown number three was eight measures of "Peter Go Ring the Bells" in F Minor. Unknown number four began exactly like unknown one, however beginning in measure three the melodic rhythm pattern was destroyed by the use of gross syncopation of the melody.

Item eight. In the unknowns of this item the melody was hidden in the base, thus distorting its pitch. The strategy used in transposing the melody into the bass was to reverse the right and left hand parts of the piano accompaniment. This was done with all four of the unknowns. First the subject heard the beginning eight measures of the familiar melody "Race You Down the Mountain" played as single notes on the piano. Unknown number one was the first eight measures of "La Tarara" with the melody in the bass. Unknown number two was the familiar melody heard

beneath a counter-melody. Unknown number three was eight measures of "Paul and the Fox" with the melody appearing in the bass part. Unknown number four began exactly like unknown number two. However in measure three, different note value patterns were substituted for those in the familiar phrase, destroying the melody rhythm.

Item nine. The distortion employed in item nine was to transpose the familiar melody into another key. The phrase was moved up a major sixth from the key of F Major to the key of D Major in the distorted version. The subject first heard the beginning eight measures of the familiar melody "Lone Star Trail" in the key of F. Unknown number one was the familiar melody transposed up into the key of D. Unknown number two was the first eight measures of "Hello, Pretty Girls" in D Major. Unknown number three began exactly like unknown number one, however, beginning at the end of measure one the melodic rhythm pattern was destroyed by changing the note values in the rest of the measures. Unknown number four was the first eight measures of "Open the Window, Noah."

Item ten. The instrumentation was deformed in item ten of the Conservation of Melody Test. The familiar melody was heard as single notes played on the piano, but all four unknowns were recorded using the tenor recorder. The pitch, therefore was not altered, only the tone color. The subject first heard the beginning eight measures of the familiar melody "Marching to Pretoria" on the piano. Unknown number one was six measures of "Que Bueno es Saber Tocar" on the tenor recorder. Unknown number two was the familiar melody played on the recorder. Unknown number three began like unknown number two, however augmentation was used in measures two, four, six, and eight, doubling the note values

in these measures and thus destroying the original melodic rhythm pattern. Unknown number four was the first four measures of "The Judge's Ball."

A summary of Conservation of Melody items appears in Appendix B. A transcription of the notation can be seen in Appendix C.

Administration of the Tests

The first step in the administration of the Conservation Test and the Conservation of Melody Test to 80 grade two subjects was to secure permission from the school authorities to enter a number of the system's schools. A written request was sent to the Director of Education. Subsequently, the researcher received a letter from the Superintendent of Elementary Education granting permission to contact the principals and grade two teachers in any of the schools in the system. Permission was also granted to carry out a pilot project in two specific schools to determine the effectiveness of the instruments and to examine the questioning procedure developed for the study.

The pilot study was carried out on 13 subjects and certain modifications were made to the instruments, the most important one being the addition of one more unknown to each of the items of the Conservation of Melody Test.

After the classrooms had been randomly selected, a letter was sent to each principal and teacher involved outlining the nature of the study and requesting permission to visit the school to conduct the research. The principal was informed of the need for a quiet room in which to carry out the study. The teacher received a list of the 10 songs that were to make up the familiar melodies in the Conservation of

Melody Test and was asked to review this material with her class. She was informed that the specific subject or subjects to be used in the study would be chosen by the researcher upon his arrival at the school.

Two days before the visit to each school, the principal was contacted and arrangements were made regarding the room in which the test was to be administered. The room selected was usually the Nurse's Office or the Staff Room. Occasionally an unused classroom was selected.

A meeting was then held with the classroom teacher and using the attendance register and a deck of numbered cards corresponding to the number of students that had been enrolled in the class at the beginning of September, the subjects were selected. The teacher was then given an information sheet and asked to record the additional data required on each child.

In setting up the room where the subjects were to be tested, the researcher tried to avoid any physical distractions. The shades were drawn to avoid any outside interference. A desk or table was arranged with a chair on either side. The surface was cleared of any objects that could distract the subject. A sign, "Testing Do Not Disturb," was fastened to the outside of the door. The items used on the Conservation Test were arranged on the table, along with the tape recorder and a tally sheet and pencil. An additional piece of paper was placed over the tally sheet so the subject would not be able to see the symbols placed there. If the room was linked by an intercom system arrangements were made to have it turned off during the testing.

Controls

The following controls were built into the administration of the

tests:

1. The Conservation Test was administered first to one subject then second to the next subject which resulted in 40 subjects having it first, and the other 40 having it second.
2. The order of the questions on the Conservation Test was cycled so that on each of the first 10 days the researcher began the test with a different item. During the last two days a different item was used for each subject.
3. The Conservation of Melody Test was preceded by both verbal instructions and an introductory test item to familiarize the subject with the nature of the test, and to put the subject at ease.
4. The questioning was very formal. Clues were avoided.
5. Positive reinforcement was used throughout by the researcher, regardless of whether the subject had answered the question correctly or not. "Very good!" was typical of the researcher's reaction to the subject's answer. All subjects were told they answered all the questions correctly.
6. The correct responses on the Conservation Test did not fall into any specific pattern that the subject would be able to recognize.
7. The ordering of the distortions on the Conservation of Melody Test, and the ordering of the unknowns was done randomly.
8. The same high quality tape recorder, a Sony TC-200 Stereo Tape recorder was used throughout the administration of the Conservation of Melody Test. The controls were maintained at the same level.
9. To insure that the subject was familiar with the Conservation of

Melody Test items the teachers were notified ahead of time what songs were to be used and requested to review the material.

Each subject was required to identify the familiar melody either by its name, the first line of its text, or by completing the first phrase after it was begun by the researcher. To further insure the familiarity of the material, it was selected from the core program for grade two.

10. The physical location where the tests were administered was free as possible from distractions of any kind.
11. The questioning procedure was standardized throughout.
12. All musical elements dealt with in each item of the Conservation of Melody Test, other than the one distorted, were held constant.
13. Each subject was shown how to keep track of the unknowns in the Conservation of Melody Test on his fingers so he could readily recall the number of the one he had selected.

Collection of the Data

All of the data relative to the Conservation Test and the Conservation of Melody Test were collected by the researcher during the administration of the test. A tally sheet was used for each subject.

The teacher was asked to provide the following data on each subject: I.Q., birth date, father's occupation and employer. In a case where the parents were separated the mother's occupation was listed. The Blishen Occupational Class Scale (Blishen, 1968), was then consulted by the researcher and the appropriate numerical value representing the parent's socio-economic status was assigned to each subject. The Otis Quick-Scoring Mental Ability Test (Otis, 1939) was administered in the

fall to all grade two pupils. In establishing the I.Q. rating, the results of this test were used.

Statistical Procedures

Variables. In order to test the hypotheses outlined in chapter one, the following variables were developed:

- X(1) = Total conservation of melody score
- X(2) = Conservers of quantity
- X(3) = Non-conservers of quantity
- X(4) = Conservers of number less than 10
- X(5) = Non-conservers of number less than 10
- X(6) = Conservers of number greater than 10
- X(7) = Non-conservers of number greater than 10
- X(8) = Conservers of length
- X(9) = Non-conservers of length
- X(10) = Conservers of area
- X(11) = Non-conservers of area
- X(12) = Subjects who scored 5 points on the Conservation Test
- X(13) = Subjects who scored 4 points on the Conservation Test
- X(14) = Subjects who scored 3 points on the Conservation Test
- X(15) = Subjects who scored 2 points on the Conservation Test
- X(16) = Subjects who scored 1 point on the Conservation Test
- X(17) = Subjects who scored 0 points on the Conservation Test
- X(18) = I.Q.
- X(19) = Male subjects
- X(20) = Female subjects
- X(21) = Age (in months)

$X(22)$ = Socio-economic status
 $X(23)$ = Score on item 1 of the Conservation Test
 $X(24)$ = Score on item 2 of the Conservation Test
 $X(25)$ = Score on item 3 of the Conservation Test
 $X(26)$ = Score on item 4 of the Conservation Test
 $X(27)$ = Score on item 5 of the Conservation Test
 $X(28)$ = Score on item 1 of the Conservation of Melody Test
 $X(29)$ = Score on item 2 of the Conservation of Melody Test
 $X(30)$ = Score on item 3 of the Conservation of Melody Test
 $X(31)$ = Score on item 4 of the Conservation of Melody Test
 $X(32)$ = Score on item 5 of the Conservation of Melody Test
 $X(33)$ = Score on item 6 of the Conservation of Melody Test
 $X(34)$ = Score on item 7 of the Conservation of Melody Test
 $X(35)$ = Score on item 8 of the Conservation of Melody Test
 $X(36)$ = Score on item 9 of the Conservation of Melody Test
 $X(37)$ = Score on item 10 of the Conservation of Melody Test

Models. The following models were constructed to test the hypotheses:

Hypothesis 1

Model 1 (full model)

$$\begin{aligned}
 X(1) = & a(12)X(12) + a(13)X(13) + a(14)X(14) + a(15)X(15) + \\
 & a(16)X(16) + a(17)X(17) + a(18)X(18) + a(19)X(19) + \\
 & a(20)X(20) + a(21)X(21) + a(22)X(22) + e
 \end{aligned}$$

Model 2 (restricted model)

$$\begin{aligned}
 X(1) = & a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) + \\
 & a(21)X(21) + a(22)X(22) + e
 \end{aligned}$$

Hypothesis 2a

Model 3 (full model)

$$X(1) = a(2)X(2) + a(3)X(3) + a(18)X(18) + a(19)X(19) + \\ a(20)X(20) + a(21)X(21) + a(22)X(22) + e$$

Model 4 (restricted model)

$$X(1) = a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) + \\ a(21)X(21) + a(22)X(22) + e$$

Hypothesis 2b

Model 5 (full model)

$$X(1) = a(4)X(4) + a(5)X(5) + a(18)X(18) + a(19)X(19) + \\ a(20)X(20) + a(21)X(21) + a(22)X(22) + e$$

Model 6 (restricted model)

$$X(1) = a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) + \\ a(21)X(21) + a(22)X(22) + e$$

Hypothesis 2c

Model 7 (full model)

$$X(1) = a(6)X(6) + a(7)X(7) + a(18)X(18) + a(19)X(19) + \\ a(20)X(20) + a(21)X(21) + a(22)X(22) + e$$

Model 8 (restricted model)

$$X(1) = a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) + \\ a(21)X(21) + a(22)X(22) + e$$

Hypothesis 2d

Model 9 (full model)

$$X(1) = a(8)X(8) + a(9)X(9) + a(18)X(18) + a(19)X(19) + \\ a(20)X(20) + a(21)X(21) + a(22)X(22) + e$$

Model 10 (restricted model)

$$X(1) = a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) +$$

$$a(21)X(21) + a(22)X(22) + e$$

Hypothesis 2e

Model 11 (full model)

$$X(1) = a(10)X(10) + a(11)X(11) + a(18)X(18) + a(19)X(19) + \\ a(20)X(20) + a(21)X(21) + a(22)X(22) + e$$

Model 12 (restricted model)

$$X(1) = a(0)U + a(18)X(18) + a(19)X(19) + a(20)X(20) + \\ a(21)X(21) + a(22)X(22) + e$$

Hypothesis 3a

Model 13 (full model)

$$X(1) = a(18)X(18) + e$$

Model 99 (restricted model)

$$X(1) = a(0)U + e$$

Hypothesis 3b

Model 14 (full model)

$$X(1) = a(21)X(21) + e$$

Model 99 (restricted model)

$$X(1) = a(0)U + e$$

Hypothesis 3c

Model 15 (full model)

$$X(1) = a(22)X(22) + e$$

Model 99 (restricted model)

$$X(1) = a(0)U + e$$

Hypothesis 4

Model 16 (full model)

$$X(1) = a(19)X(19) + a(20)X(20) + e$$

Model 99 (restricted model)

$$X(1) = a(0)U + e$$

MULRØ5 (Multiple Linear Regression Analysis) was used to test the above hypotheses. The means and standard deviations of each variable were calculated, along with F ratios for each hypothesis.

DESTØ2 (Descriptive Statistics) was used to find the correlations between all the variables for the total sample. DESTØ2 was also used to test the probability that each correlation was equal to zero.

All of the above analyses were completed through the computer facilities of the University of Alberta, Edmonton, Canada. An IBM 360-67 computer was the instrument which carried out the computations.

CHAPTER IV

THE RESULTS OF THE INVESTIGATION

The results of the Conservation Test and the Conservation of Melody Test are summarized and analyzed in this chapter. The analysis of the results in terms of the stated hypotheses, and the results of the investigation into correlations between all the variables are also presented.

In order to test the hypotheses, 80 grade two children (39 boys and 41 girls) were randomly selected to participate in the study. A Conservation Test (see Appendix A) and a Conservation of Melody Test (see Appendix B) were administered individually to each subject. In addition, data on age, I.Q. and socio-economic status were collected from the cumulative records of the subjects. For the sample the mean chronological age was 97.85 months with a standard deviation of 4.73. Figure 1 (Chapter III) shows the frequency distribution of the ages of subjects. The mean I.Q. of the sample was 113.95 with a standard deviation of 11.97. The distribution of I.Q. scores is illustrated in Figure 2. The mean rating on the Blishen Occupational Class Scale was 42.92 with a standard deviation of 12.94. Information regarding socio-economic status distribution is shown in Figure 3.

The Conservation Test

This five-item test was designed to assess five areas of

conservation. Table I shows the percent of subjects who answered each item correctly. The percentage of correct responses on each item ranged from 38.75 to 51.25 indicating that no item was inordinately more difficult than any other item for the members of the sample. Item two, related to number less than 10, was the most difficult. Items four and five, related to length and area, were the easiest. An examination of the scores on the Conservation Test (Figure 4) reveals

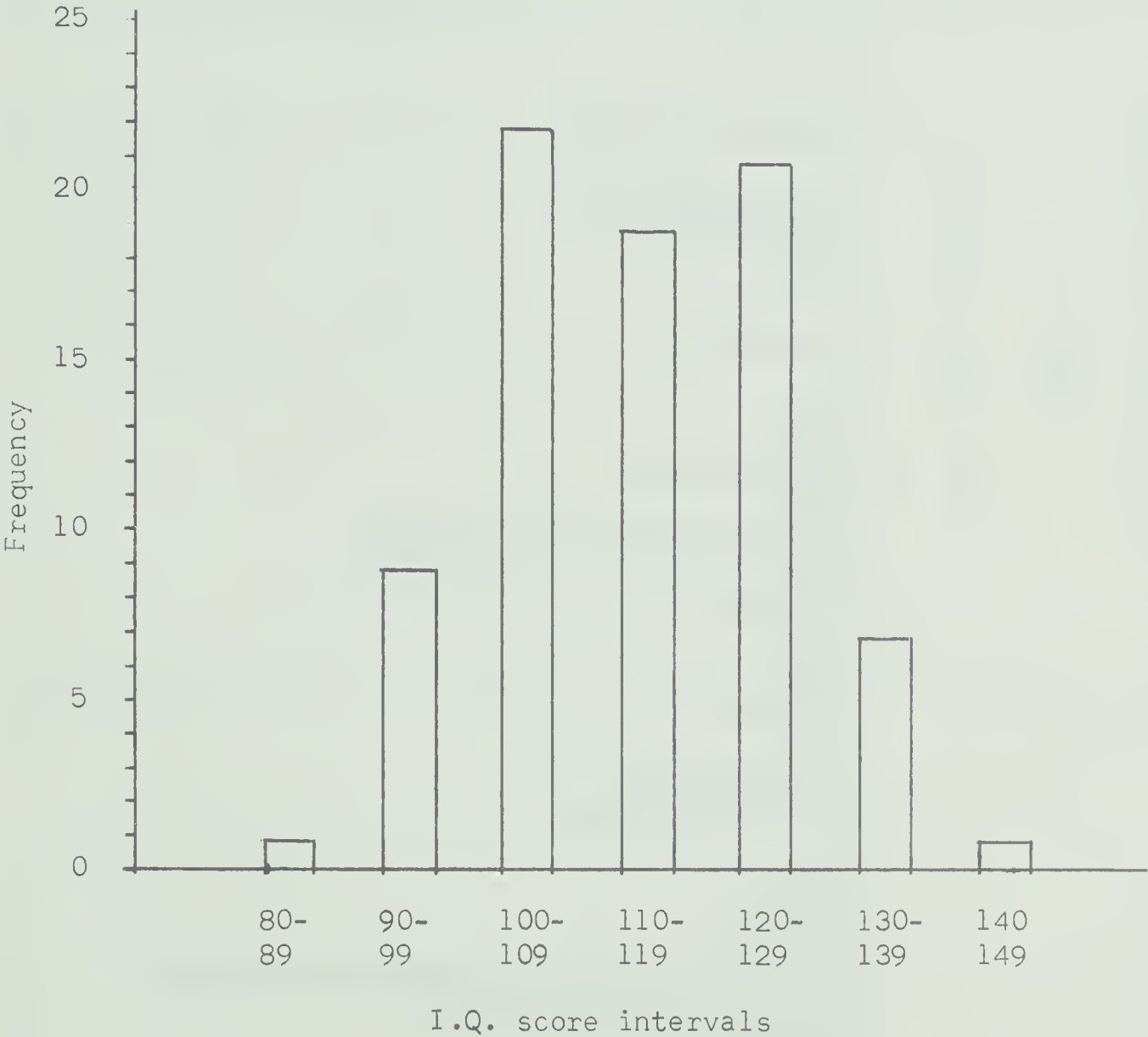
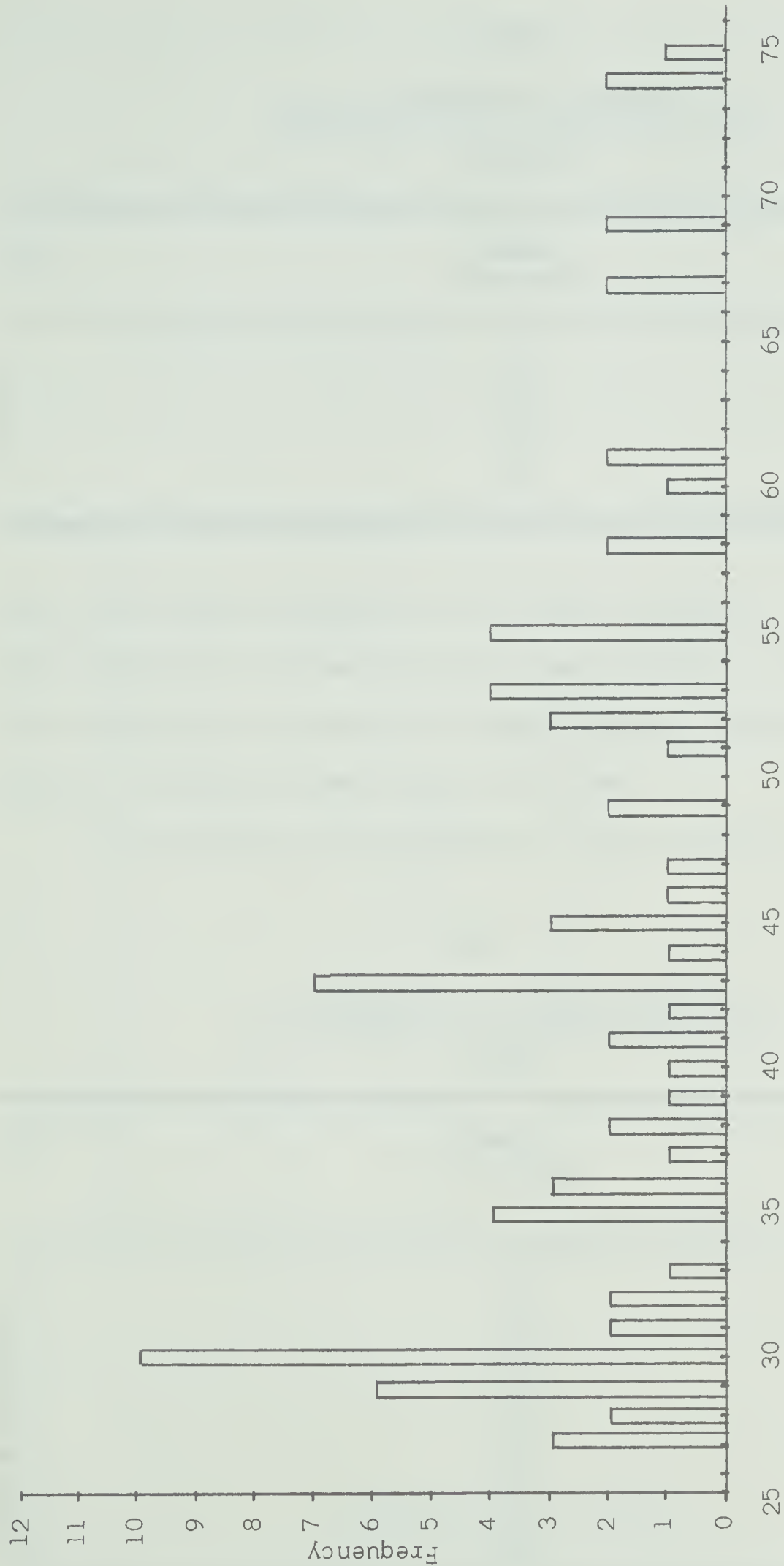


FIGURE 2

FREQUENCY DISTRIBUTION OF I.Q. SCORES
(N=80)



S.E.S. score intervals

FIGURE 3
 FREQUENCY DISTRIBUTION OF
 SOCIO-ECONOMIC STATUS SCORES
 (N=80)

TABLE I

PERCENTAGE OF CORRECT
RESPONSES ON THE CONSERVATION TEST
(N=80)

Item	Number Successful	Percent Successful
1	36	45.00
2	31	38.75
3	38	47.50
4	41	51.25
5	41	51.25

that four subjects answered all five items correctly, 11 answered four items correctly, 23 answered three items correctly, 19 answered two items correctly, 16 answered one item correctly, and seven subjects failed to correctly answer any of the items.

The criterion that was used to score the five items individually

TABLE II

PERCENTAGE OF CORRECT ANSWERS
ON EACH PART OF THE CONSERVATION TEST
(N=80)

Part	Number Successful	Percent Successful
1a	51	63.75
1b	47	58.75
2a	38	47.50
2b	61	76.25
3a	70	87.50
3b	45	56.25
4a	50	62.50
4b	64	80.00
5a	43	53.75
5b	42	52.50

was that a subject must perform correctly on both parts to be considered a conserver in that particular area. A score of one was assigned to the conservers and a score of zero was assigned to those who failed on one or both of the parts that made up each item. The percentage of subjects who were successful in each of the parts is given in Table II.

The results of item one. This item was designed to measure the subject's ability to recognize that a continuous quantity such as colored water remains invariant when poured into containers of a

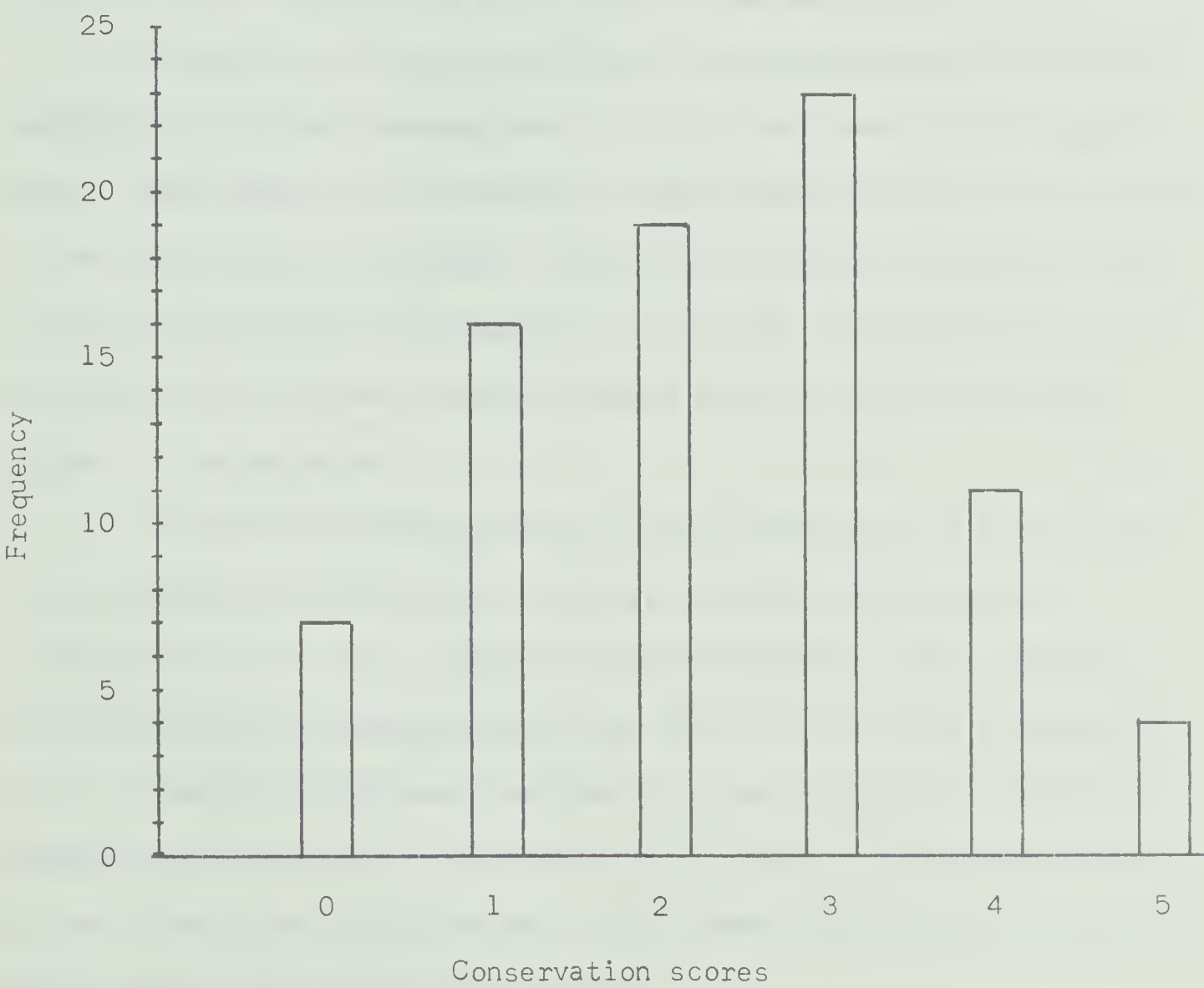


FIGURE 4
DISTRIBUTION OF TOTAL
CONSERVATION TEST SCORES
(N=80)

different size and shape. It was also designed to measure the subject's ability to realize that if part of a semi-continuous quantity such as rice, were removed the two volumes would not be the same despite perceptual impressions to the contrary.

In part 1a, 51 subjects (63.75%) stated correctly that the quantity of water had not changed. Twenty-nine subjects (36.75%) thought that the quantity of water had changed. "There's more here (indicating the glass) because these (indicating the thin containers) are smaller," was a typical response from the non-conservers.

In part 1b, 47 subjects (58.75%) responded correctly that the quantity of rice had changed, and that there was more in the original glass. When asked why, "Because you dumped some out," was the response in the vast majority of cases. Thirty-three subjects (41.25%) thought that the quantity had not changed, or felt that the quantity of rice in the tall thin vessel was greater because the level of the rice was higher in the container.

Of the 80 subjects tested, 36 (45%) answered both parts of the conservation of quantity item correctly and were designated as conservers in this area. Eighteen subjects answered both questions incorrectly and 26 answered one or the other of the parts incorrectly. These 44 subjects (55%) were designated as non-conservers because the researcher on the basis of two questions, could not be certain whether, in the case of one correct answer, this answer had not been arrived at by guessing on the part of the subject.

Results of item two. This item was designed to test the subject's ability to recognize that a small group (less than 10) of objects retains the same numerical characteristic despite a

transformation. It was also designed to measure the subject's ability to realize that this aspect is destroyed if one of the objects is removed, despite perceptual impressions to the contrary.

In part 2a, 38 subjects (47.5%) counted each group and answered correctly that there were more red blocks. Forty-two subjects (52.5%) either thought that the number of blocks was still the same or that there were more red blocks because this row was longer in length. This part proved to be the most difficult of all the 10 parts of the test.

In part 2b, 61 subjects (76.25%) responded correctly that there were equal numbers of red and white blocks. Nineteen subjects (23.75%) suggested that there were more white blocks. "Because it's longer," was a typical answer when the subject was asked to explain his reasoning.

Only 31 subjects (38.75%) answered both parts correctly, making this the most difficult item on the conservation test. These children were awarded a score of one. All others (61.25%) received a score of zero. Twelve subjects answered both parts incorrectly, while 37 subjects responded incorrectly to one or the other of the parts.

Results of item three. This item was designed to measure the subject's ability to recognize that groups of objects greater than ten remain invariant under transformations.

Part 3a proved to be the easiest. Seventy subjects (87.5%) responded that the number of beads in each container was still the same. Ten subjects (12.5%) answered incorrectly, suggesting that there were fewer beads in the larger vessel.

In part 3b, 45 subjects (56.25%) responded correctly that the number of blue and yellow squares was equal. Of the 35 subjects (43.75%) who answered the question incorrectly, most suggested that there were

more blue squares.

Of the 80 subjects, 38 (47.5%) were classed as conservers in this area. Only 3 subjects answered both parts incorrectly, while 39 subjects responded correctly to one part and incorrectly to the other. These two groups (52.5%) were given a score of zero and were designated as non-conservers of number greater than 10.

Results of item four. This item was designed to measure the child's ability to recognize that the length of an object remains invariant in spite of transformations. It was also designed to test the subject's ability to recognize that this feature is destroyed when one of the objects is shortened.

In part 4a, 50 subjects (62.5%) answered correctly that the red rod was longer. The majority of the 30 subjects (37.5%) who answered incorrectly felt that the white rod was longer in view of the fact that it had been placed on the inverted glass. In a few cases the subject appeared uncertain whether he should consider the height of the glass in his measurement and asked, "Do you mean the glass too?" These subjects were told, "No." The subject then usually responded correctly to the question. In a very few cases the subject responded, "The white one is higher." In these cases the researcher repeated the question, "Do you think that the red one is longer, that the white one is longer, or do you think that they are both the same length?" In all of these cases the subject's response did not change. He merely substituted the word "longer" for "higher" in answering the question.

In 4b, 64 subjects (80%) responded correctly that the two rods were equal in length despite the fact that the ends of the rods did not coincide.

In this item, 41 subjects (51.25%) achieved a score of one because they answered both parts correctly. Of the group of 39 (48.75%) who received a score of zero, 7 answered both questions incorrectly and 32 missed one of the questions on the conservation of length item.

Results of item five. This item was designed to measure the child's ability to recognize that the spatial arrangement of objects within an area remains invariant despite transformations.

In part 5a, 43 subjects (53.75%) arranged the apparatus correctly, while 37 (46.25%) constructed a mirror image of the investigator's arrangement.

In part 5b, 42 subjects (52.5%) arranged the bricks correctly, while 38 subjects (47.5%) constructed a mirror image of the investigator's arrangement.

Children who arranged the pieces correctly in both parts of this item were given a score of one and designated as conservers of area. Forty-one subjects (51.25%) fell into this category. Thirty-six subjects arranged a mirror image in both parts. Three children arranged the first group correctly, but missed the second one. A total of 39 subjects (48.75%) were classed as non-conservers of area.

The Conservation of Melody Test

This ten-item test was designed to assess conservation of melody under ten different transformations. Table III shows the percentage of subjects who answered each item correctly. The percentage of correct responses on each item ranged from 28.75 to 95 indicating that, while seven of the items were easy, items three, six, and eight involved transformations that were very difficult for this age group to overcome.

TABLE III
PERCENTAGE OF CORRECT ANSWERS
ON THE CONSERVATION OF MELODY TEST
(N=80)

Item	Number Successful	Per cent Successful
1	73	91.25
2	76	95.00
3	23	28.75
4	74	92.50
5	68	85.00
6	33	41.25
7	62	77.50
8	29	36.25
9	63	78.75
10	69	86.25

An examination of Figure 5 reveals that one subject answered all of the ten items correctly, 13 answered nine items correctly, 23 answered eight items correctly, 16 answered seven items correctly, 15 answered six items correctly, nine answered five items correctly, and three answered four items correctly. None of the subjects tested answered fewer than four items correctly.

Results of item one. This item was designed to measure the subject's ability to recognize that a musical phrase remains invariant despite a transformation of its pitch. In spite of a pitch distortion of two octaves, 73 of the 80 subjects (91.25%) tested were able to correctly identify the familiar melody. These children were awarded a score of one and designated as conservers of melody under pitch transformation.

Results of item two. Item two was designed to measure the subject's ability to recognize that a melody remains invariant despite

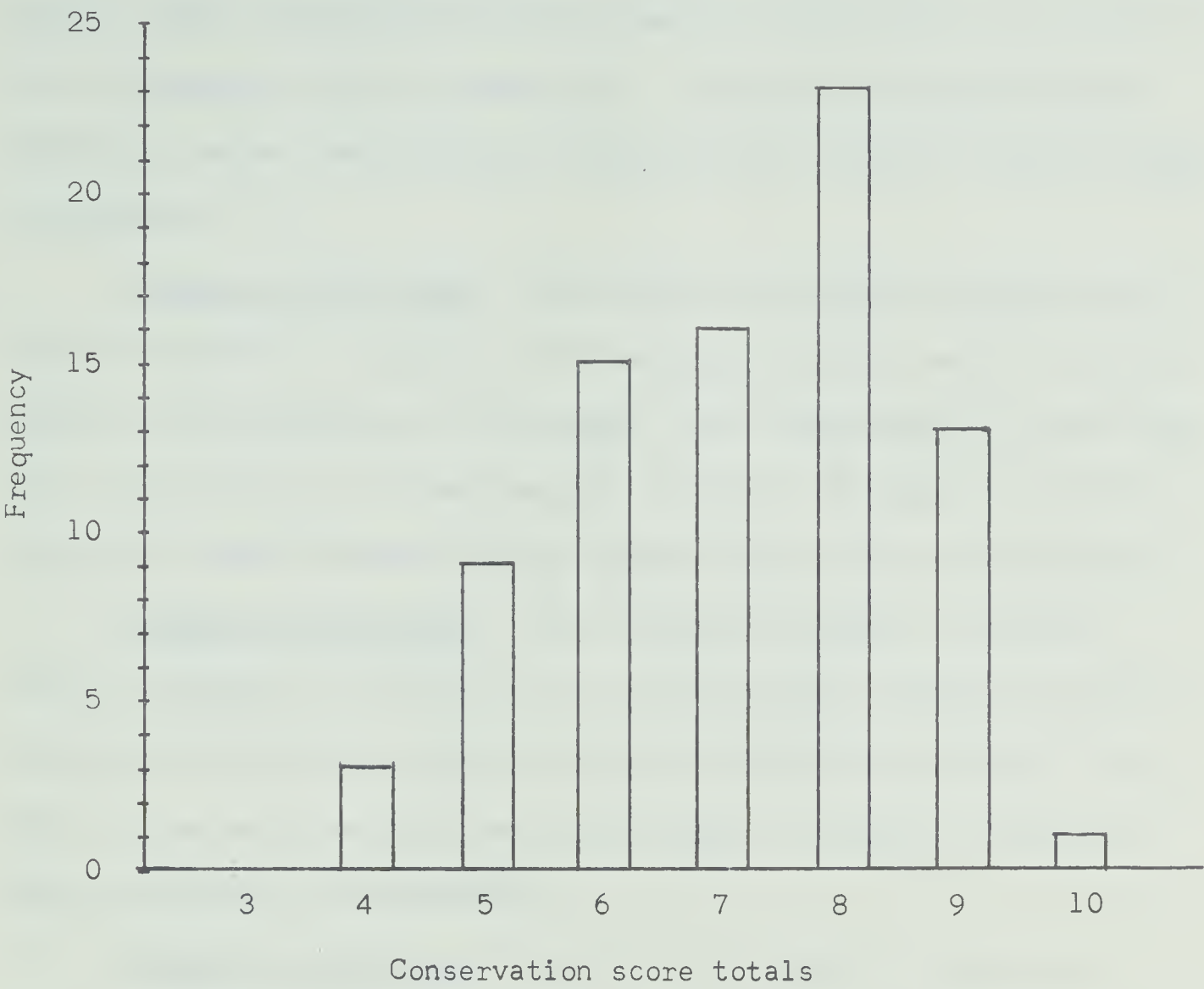


FIGURE 5
DISTRIBUTION OF TOTAL SCORES ON
THE CONSERVATION OF MELODY TEST
(N=80)

a transformation in dynamics. This proved to be the easiest distortion to overcome, for 76 of the 80 subjects (95%), were able to correctly identify the melody when it was played much louder.

Results of item three. This item was designed to test the subject's ability to realize that a musical phrase remains invariant although it is hidden in a variation on the original tune. Only 23 of the subjects (28.75%) were able to correctly identify the melody. Of those tested, 57 subjects (71.25%), were unable to break down the more

complex tonal configuration and disregard the additional sounds that had been incorporated into the variation. The variation transformation proved to be the most difficult obstacle for children of this age group to overcome.

Results of item four. Item four was designed to measure the subject's ability to recognize that a musical phrase remains invariant despite a transformation in the tempo. This transformation proved very easy for the subjects to overcome, as 74 of the 80 subjects (92.5%) accurately identified the familiar phrase that had been transformed.

Results of item five. This item was designed to test the subject's ability to realize that a familiar phrase remains invariant in spite of the addition of a mis-matched harmony in the bass. Sixty-eight of the subjects (85%) tested were able to conserve the melody despite the above transformation.

Results of item six. Item six was designed to measure the subject's ability to recognize that a familiar phrase remains invariant despite a transformation in the meter. Only 33 subjects (41.25%) were able to successfully identify the melody that had been distorted in this fashion. It was obvious to the researcher that the first unknown (the correct answer) was immediately rejected by many of the subjects because they were unable to disregard the meter change. Because the transformed melody did not move in duple time it was rejected. Then, after all the unknowns were heard and the meter was triple in every case, the subject was forced to guess. The rhythmic approach to melody by many children of this age group became evident as a result of their inability to solve the problem presented in this item.

Results of item seven. This item was designed to test the

subject's ability to realize that a familiar phrase remains invariant in spite of a transformation in the mode. Of the 80 children tested, 62 (77.5%) were able to overcome the deformation of the mode and locate the appropriate unknown.

Results of item eight. Item eight of the Conservation of Melody Test was designed to measure the subject's ability to recognize that a familiar phrase remains invariant despite the addition of an accompanying pattern above it. Only 29 of the subjects (36.25%) tested were able to disregard the higher melodic figure and focus their attention on the familiar melody appearing in the bass line. The other 51 subjects (63.75%) listened only to the top line of the melody and could not locate the appropriate unknown. Many of them suggested that none of the unknowns sounded anything like the familiar tune. It would appear that many children in this age group are only able to listen horizontally to the highest pitched melody figure in a piece of music.

Results of item nine. This item was designed to test the subject's ability to realize that a familiar melody remains invariant in spite of a deformation involving its transposition into another key. Of the 80 subjects tested, 63 (78.75%) were able to locate the familiar phrase despite the transformation from the key of F to the key of D.

Results of item ten. This item was designed to measure the subject's ability to recognize that a familiar phrase remains invariant despite a transformation in its tone color. Of the subjects tested, 69 (86.25%) were able to disregard the instrumentation and correctly answer this item.

Analysis of the Results in Terms of the Stated Hypotheses

In order to test the first four hypotheses Multiple Linear Regression Analysis was applied to the data and F ratios were established. The MULR05 program, documented by the Division of Educational Research Services, University of Alberta (programmers: Ward, Flathman, and Hunka), was used. This program permits the calculation of squared multiple correlation coefficients for the linear model specified as:

$$X = a(1)X(1) + a(2)X(2) + \dots a(n)X(n)$$

where X is the criterion variable to be predicted and X(1) to X(n) are the predictor variables. The weights "a" are also calculated. The level at which the probabilities would be accepted as significant was .05.

Hypothesis 1. There is no significant difference in scores on the Conservation of Melody Test among the six groups formed on the basis of their conservation scores, controlling for I.Q., sex, age, and socio-economic status.

An examination of Table IV reveals an F ratio of .568 and a probability of .710. The difference in scores among the groups is not significant at the .05 level, therefore the hypothesis is accepted. If the Conservation of Melody Test that was used in this research is accepted as a measure of the child's conservation of melody ability, then it can be stated that knowledge of a subject's conservation score will not enable his conservation of melody ability to be predicted accurately, when controlling for I.Q., sex, age, and socio-economic status.

Hypothesis 2. There is no significant difference in scores on

TABLE IV
ANALYSIS OF HYPOTHESES ONE, TWO, THREE, AND FOUR
IN TERMS OF F RATIOS AND PROBABILITIES

Hypothesis	F Ratio	Probability
1	0.568	0.710
2a	0.299	0.568
2b	2.255	0.137
2c	0.525	0.471
2d	0.118	0.733
2e	0.846	0.361
3a	1.296	0.258
3b	2.282	0.135
3c	3.783	0.055
4	0.922	0.340

the Conservation of Melody Test, holding I.Q., sex, age, and socio-economic status constant, between conservers and non-conservers of (a) quantity, (b) number less than 10, (c) number greater than 10, (d) length, and (e) area.

This hypothesis was also accepted, for as shown in Table IV (2a, 2b, 2c, 2d, 2e) none of the F ratios approached significance, at the .05 level.

Hypothesis 3. No significant relationship exists between the ability to conserve melody and the child's (a) I.Q., (b) chronological age, and (c) socio-economic status.

This hypothesis was also accepted because none of the F ratios were significant at the .05 level. It is important to note however, that the relationship of .055 between the conservation of melody score and socio-economic status comes very close to being accepted as significant. A discussion of this relationship is presented in Chapter V.

Hypothesis 4. There is no significant difference in scores on

the Conservation of Melody Test between males and females.

This hypothesis was also accepted because the F ratio was not significant. A summary of these data is shown in Table IV.

Hypothesis 5. No significant correlations exist between the scores on the individual items in the Conservation Test and the individual items in the Conservation of Melody Test.

The Pearson Product Moment Correlations Program was utilized to find correlations between all the variables. This program calculated the means, standard deviations, and a square symmetric matrix of Pearson product moment correlations. None of the respective correlations were significant with the exception of one, which was a correlation of .514 between the conservation of melody score and the membership vector representing a correct response to item nine on the Conservation of Melody Test. Nothing of any importance can be drawn from this relationship. Therefore the hypothesis was accepted. A scatter diagram of the conservation and conservation of melody scores is shown in Figure 6.

Correlations of other variables. The conservation score, conservation of melody score, and the scores on the various items in the two tests do not correlate significantly with I.Q., sex, age, or socio-economic status. Appendix D shows the results of the analysis performed on all the variables in terms of ranges, means, and standard deviations.

Additional Analysis Performed on the Data

Two groups of subjects, conservers and non-conservers, were formed on the basis of the performance on the items in the Conservation

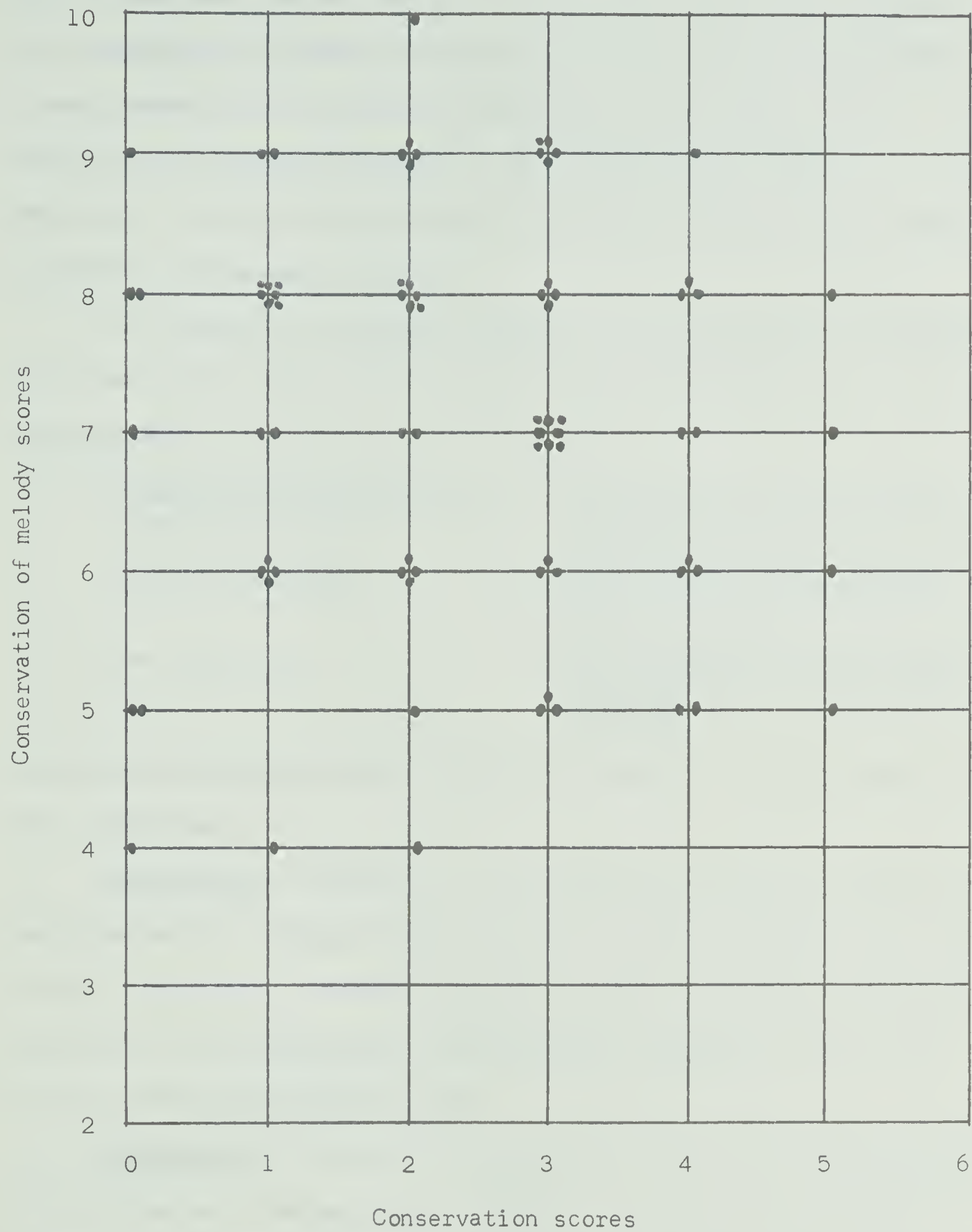


FIGURE 6

SCATTER DIAGRAM FOR THE TOTAL CONSERVATION TEST SCORES
AND THE TOTAL CONSERVATION OF MELODY SCORES
($r = -.042$)

Test. Those who answered one of the two parts in each item correctly were classed as non-conservers rather than partial conservers because it was assumed that it would be impossible, on the basis of two questions, to determine whether the child was indeed a partial conserver. In eight of the ten questions he had a one-in-three chance of guessing the answer correctly.

As a matter of interest, however, another grouping of subjects was formed on the basis of the results on the Conservation Test. The grouping was:

Conservers of the particular area in question	— Those subjects who correctly answered both parts of the item.
Partial conservers	— Those subjects who correctly answered one part of the item.
Non-conservers	— Those subjects who were unable to answer any of the two parts correctly.

The following hypotheses were formulated to examine the data under the above conditions:

Hypothesis 6. There is no significant difference in scores on the Conservation of Melody Test among the 15 groups formed on the basis of their conservation scores (conservers, partial conservers, and non-conservers in the five areas of conservation), controlling for I.Q., sex, age, and socio-economic status.

Hypothesis 7. There is no significant difference in scores on the Conservation of Melody Test, holding I.Q., sex, age, and socio-economic status constant, between conservers, partial conservers, and non-conservers of (a) quantity, (b) number less than 10, (c) number greater than 10, (d) length, and (e) area.

Multiple Linear Regression Analysis was applied to the data to test

these hypotheses.

Hypotheses 6, 7a, 7b, 7c, and 7d were accepted. However, the F ratio of 5.323 for hypothesis 7e is significant at the less than .05 level. Hence it was concluded that knowledge of the score on the area item of the Conservation Test is a significant predictor of the total score on the Conservation of Melody Test, if subjects are grouped according to the procedure outlined above. A summary of the additional analysis appears in Table V.

Reliability of the Instruments

The internal consistency of the Conservation Test and the Conservation of Melody Test was assessed by computing the Kuder-Richardson reliability coefficient. The Kuder-Richardson 20 formula provides an indication of the extent to which the distribution of the sample on each item parallels the distribution of the sample on the whole test, or the extent to which each item measures what the whole test measures. The reliability coefficient for the Conservation Test was .319. For the Conservation of Melody Test the reliability

TABLE V
ANALYSIS OF TWO ADDITIONAL HYPOTHESES
IN TERMS OF F RATIOS AND PROBABILITIES

Hypothesis	F Ratio	Probability
6	1.752	0.087
7a	0.201	0.819
7b	1.191	0.309
7c	1.069	0.348
7d	0.069	0.933
7e	5.323	0.007

coefficient was .275. These data indicate a low internal consistency in each of the instruments.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

Summary

The purpose of this research was to investigate the possibility of a relationship existing between the grade two child's ability to conserve in certain areas, and his ability to recognize familiar melodies that had been distorted in certain ways. Attention was also focused on the relative difficulty encountered at the grade two level in overcoming certain musical deformations. The assumption was that some would be more complex than others.

A sample of 80 subjects was selected randomly from the total grade two population that had been enrolled in the school system at the beginning of the 1969-70 academic year. The sample consisted of 39 boys and 41 girls from 56 grade two classrooms located in 40 elementary schools. The ages of these children ranged from 7.50 years to 9.69 years. The intelligence quotient, as rated on the Otis Quick-Scoring Mental Ability Test, was taken from the academic record of each subject. Intelligence scores ranged from 83 to 140. The Blishen Occupational Class Scale was used to rate the socio-economic status of each subject. These ratings ranged from 26.6 to 75.2.

The child's development of conservation was investigated by means of an instrument adapted by the researcher from a study done by Reimer. It consisted of five items, each containing two parts, designed

to focus upon five specific areas of conservation. The first item measured conservation of quantity, continuous and discontinuous; the second measured conservation of number less than ten; the third item measured conservation of number greater than ten; the fourth item measured conservation of length; and the fifth item measured conservation of area.

The child's development of conservation of melody was measured using an instrument developed by the researcher, and based on studies carried out by Zimmerman. It consisted of ten items each designed to measure the ability to conserve melody after different deformations had been introduced. The first item involved pitch distortion. The second item involved dynamics distortion. In the third item the melody was hidden in a variation. The fourth item involved tempo distortion. The fifth item involved a distorted harmony. In the sixth item the meter was distorted. The mode was distorted in item seven. In the eighth item the melody was hidden in the bass. The melody was transposed in item nine. The tenth item involved instrumentation distortion.

The two tests were administered to each subject during the period of May 4th to 20th, 1970. Each subject was tested individually by the investigator.

The data gathered were analysed using the Multiple Linear Regression Analysis program and the Pearson Product Moment Correlations program documented by the Division of Educational Research Services, University of Alberta. A measure of reliability was calculated for each instrument using the Kuder-Richardson 20 formula.

Conclusions

The following conclusions were drawn on the basis of the hypotheses tested and the data analysis presented in Chapter IV.

1. For the grade two children tested, there is no significant difference in scores on the Conservation of Melody Test among the groups of subjects who achieved a score of 5, 4, 3, 2, 1, and 0, on the Conservation Test, controlling for I.Q., sex, age, and socio-economic status.
2. There is no significant difference in scores on the Conservation of Melody Test, holding I.Q., sex, age, and socio-economic status constant, between conservers and non-conservers of (a) quantity, (b) number less than ten, (c) number greater than ten, (d) length, and (e) area.
3. No significant relationship exists between the child's ability to conserve melody and his (a) I.Q., (b) chronological age, and (c) socio-economic status. The relationship between the conservation of melody score and socio-economic status was significant at the .056 level, and therefore came very close to being accepted at the .05 level. It would appear that perhaps children from higher socio-economic backgrounds have a more sophisticated understanding of melody because they have a cultural advantage, or perhaps it is because some of these children have been involved in pre-school education of one form or another.
4. There is no significant difference in scores on the Conservation of Melody Test between boys and girls.

5. No significant correlations exist between the scores on the individual items in the Conservation Test and the individual items in the Conservation of Melody Test. Not only is there no possibility of predicting a child's total score on one test from his score on the other, but it is impossible to predict the subject's score on any item of one test from his score on any item of the other.
6. It is important to note that three items on the Conservation of Melody Test were extremely difficult for children of this age group to master, indicating that many of the subjects were unable to conserve melody under the conditions presented in these questions. In two of these items the melody was hidden. When it appeared in a variation only 29% of the subjects were able to identify it. When the melody appeared in the bass with a counter-melody above it only 36% of the children were capable of correctly locating it. The other very difficult item involved the distortion of meter. It would appear that a transformation of meter is extremely difficult to overcome, because only 41% of the subjects were able to identify a familiar melody that had been altered in this fashion. The conclusion drawn from this information is that the majority of grade two children have not yet reached the stage where they can conserve a familiar melody where it has been distorted in the ways outlined above.

Implications

With the exception of the items on the Conservation of Melody

Test involved with hiding the melody either within a more complex tonal configuration or placing it below a counter-melody, and the item involving meter distortion, the grade two children scored very high. The average percentage of subjects who correctly answered the other items on the test was 86.18%. This would seem to suggest that it is feasible to include melody recognition tasks involving transformations in pitch, dynamics, tempo, harmony, mode, transposition, and tone color as part of a listening program at this level. This study indicates that most of the subjects tested were capable of conservation of a familiar melody that had been deformed as outlined above.

This study has identified three areas where children of this age group are weak, namely meter transformations, variations, and polyphony. If further studies suggest that conservation of melody can be enhanced by special instruction, (Zimmerman and Sechrest have begun investigations into this area of research) then perhaps efforts to enhance conservation of melody might be focused in the above three areas.

Suggestions for Further Research

1. Although no significant relationship was found in this study between conservation and conservation of melody, further studies should be carried out in an effort to investigate whether various theories regarding child development can be applied to music education. It is only by building a large corpus of research that the music education programs of the future will meet the needs of ever increasing numbers of children.
2. In view of the broad scope of each of the tests it is not surprising that the internal consistency of each instrument was

low, as indicated by the application of the Kuder-Richardson 20 formula. Due to the length of each test, it was not possible to offer a sufficient number of questions in each area of conservation examined. In order for the reliability of each of the instruments to be accurately determined the scope of each might have been narrowed. Then through various trials appropriate questions in each area could have been selected to yield a high reliability coefficient. It is recommended that if any portion of this study is replicated the scope of each of the instruments should be narrowed in an effort to improve the internal consistency.

3. With respect to the concept of conservation of melody, more intensive studies could be pursued--studies that are both longitudinal and cross-sectional in their scope--to determine how children develop an understanding of melody.
4. Because the listening program cannot be divorced from the other important facets of music education, studies could be carried out to identify situations where other activities have had a meaningful effect on the development of listening skills. Conversely, efforts to integrate listening experiences into other areas of the music education curriculum that appear to have been worthwhile should be studied. It may be that other music education activities can contribute significantly to the child's understanding of melody.

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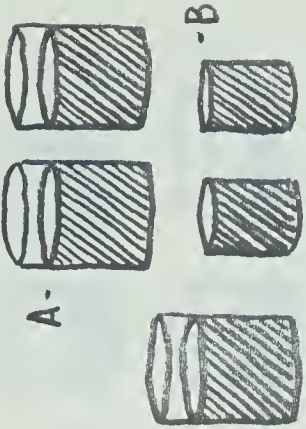
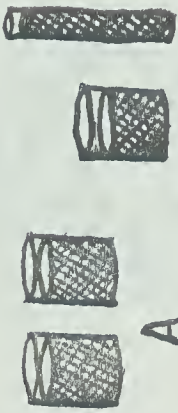

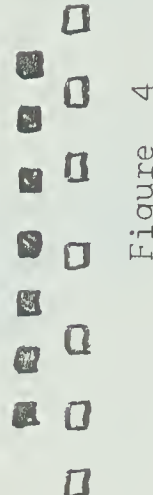
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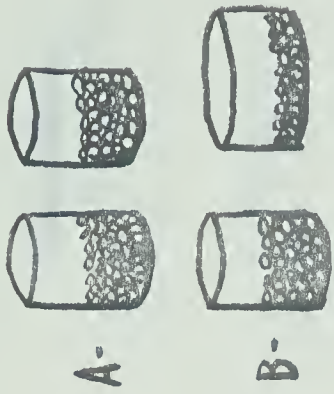

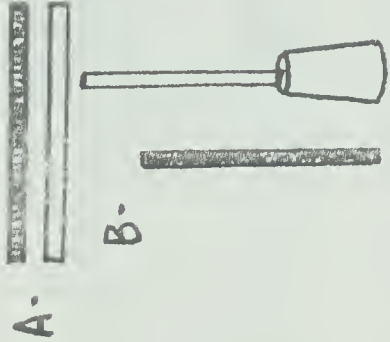
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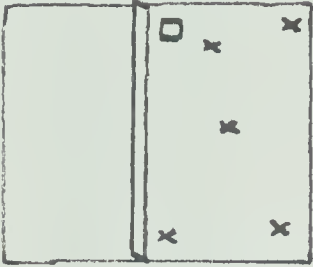
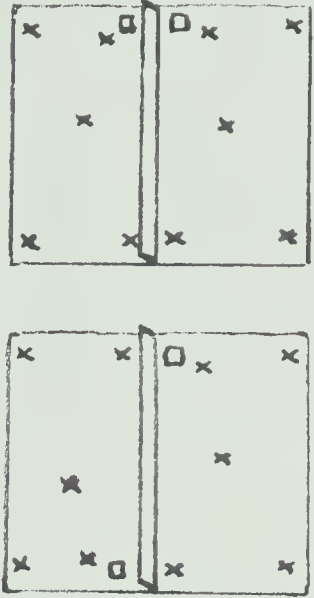
APPENDICES

APPENDIX A

CONSERVATION TEST

Item	Conservation Concept	Objects Used	Procedure	Positioning of Objects
1A	Quantity (continuous)	2 identical jars 2 smaller identical jars colored water	Place the two larger jars before the child and ask if there is the same amount of water in each. Pour water from one to the other until the child is satisfied the amounts are equal (Fig. 1-A). Then pour the contents from one jar into the two smaller jars (Fig. 1-B). "Is there more water here (2 smaller jars), or here (large jar), or is there the same here and here?" "Why?"	 Figure 1
1B	Quantity (discontinuous)	2 identical jars 1 tall thin jar rice	Pour the rice into the 2 identical jars until the subject is satisfied they contain the same quantity (Fig. 2-A). Then take some out of one jar and pour the rest into the tall thin jar (Fig. 2-B). "Is there more rice here, or here, or is there the same amount both here and here?" "Why?"	 Figure 2
2A	Number (less than ten)	7 red blocks 7 white blocks	Place the 7 red blocks in a row (Fig. 3-A) and ask the subject to put just as many white as there are red in a row beneath the red ones. Then remove one red block and arrange the white blocks into a close bunch (Fig. 3-B). "Are there more red blocks, or more white blocks, or the same number of red and white?" "Why?"	 Figure 3
2B			Return the red and white blocks to their original position (Fig. 3-A) then spread the white blocks out and repeat the questions in 2A (Fig. 4)	 Figure 4

Item	Conservation Concept	Objects Used	Procedure	Positioning of Objects
3A	Number (greater than ten)	30 beads 2 identical glass jars 1 larger jar	Ask the subject to take a bead in each hand and to put the bead from one hand into one of the identical jars and the bead from the other into the other jar (Fig. 5-A) until all beads are used up. The child should be convinced that there are the same number of beads in each jar. Then pour the beads from one jar into the larger jar (Fig. 5-B). "Are there more beads here, or here, or are there the same number of beads here and here?" "Why?"	 <p>Figure 5</p>
3B		sheet of paper with 12 yellow squares and 13 blue squares	"Look at this paper carefully. Are there more yellow squares pasted on it, or more blue squares or the same number of yellow and blue squares pasted on it?"	 <p>Figure 6</p>
4A	Length	2 sticks constructed from "Mini-Bricks" that have equal lengths a glass	Hand the sticks to the child and ask him which is longer. He should be convinced that they have the same length. (You could assist him by laying them parallel so their end points coincide Fig. 7-A.) Then remove the end section of one, therefore shortening it, and place them in a vertical position, placing the shorter one on the inverted glass (Fig. 7-B). "Is the one on the glass longer, or are they both the same length?" "Why?"	 <p>Figure 7</p>

Item	Conservation Concept	Objects Used	Procedure	Positioning of Objects
4B			Return the sticks to equal length and ask the subject which one is longer. He must be convinced that they have the same length. Assist him in laying them parallel (Fig. 7-A). Then move one of sticks to the right or left an inch or two (Fig. 8). "Which one is longer now, or they both still the same length?" "Why?"	
5A	Area	2 red blocks (each representing a barn) 4 pairs of toy farm animals 1 white plastic fence small table	Ask the subject to come and stand by your side at one end of the small table. Set up the fence dividing the table top equally. "Here is my farm, with the fence at the back. I'm going to put my barn over here, and my animals like this (Fig. 9). Now take a good look at the way I have set the farm up. (Review the placement) You take your animals and barn around the table to your farm and see if you can set them up exactly as I have done." The child is permitted to return to the other side of table and check until satisfied.	
5B		6 red blocks 6 white blocks 1 plastic fence	The table is cleared and the same procedure followed using a different arrangement of objects, this time red and white blocks. [Conservers will arrange them correctly (Fig. 10-A). Non-conservers will arrange a mirror image (Fig. 10-B)]	

APPENDIX B

CONSERVATION OF MELODY - TEST ITEMS

Items	Distortion	Familiar Melody Used
1	Pitch distortion. The phrase was heard two octaves higher as unknown number three.	"Good-by, Old Paint"
2	Dynamics distortion. The phrase was first heard mf, then was heard ff as unknown number two.	"In the Barnyard"
3	Tonal configuration hidden by a variation on the melody that featured the recurrence of the tonic note. The phrase appeared as unknown number two.	"Sandy Land"
4	Tempo distortion. The familiar phrase was played at = 96. It was later heard at = 192 as unknown number three.	"Cotton Needs Picking"
5	Harmony distortion. The familiar melody was first heard using single notes on the piano, then accompanied by a harmony pitched a fourth up from the correct key center. The distorted phrase appeared as unknown number two.	"Clap Your Hands"
6	Meter distortion. The familiar phrase moved in duple time. The distorted melody was unknown number one and moved in triple time, as did all the unknowns.	"On the Bridge to Avignon"
7	Mode distortion. The familiar phrase was in G Major. The distorted phrase appeared as unknown number one in G Minor.	"Paper of Pins"
8	Melody hidden in bass. The familiar phrase was heard using single notes on the piano. In the distorted version it occurred as unknown number two with the bass and treble parts of the piano accompaniment reversed.	"Race You Down the Mountain"

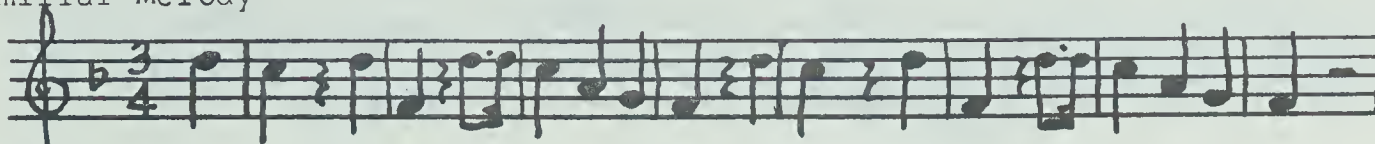
Items	Distortion	Familiar Melody Used
9	Melody transposed. The familiar phrase was heard in the key of F Major, then was presented as unknown number one in the key of D Major, up a major sixth.	"Lone Star Trail"
10	Instrumentation distortion. The familiar phrase was heard as single notes on the piano. The four unknowns were then heard on the tenor recorder. The distorted phrase appeared as unknown number two.	"Marching to Pretoria"

APPENDIX C

CONSERVATION OF MELODY TEST

I - PITCH DISTORTION

Familiar Melody



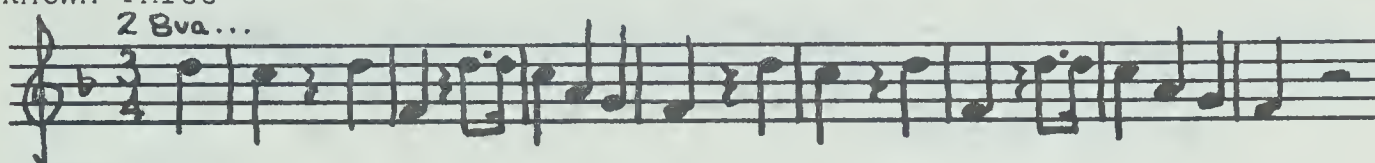
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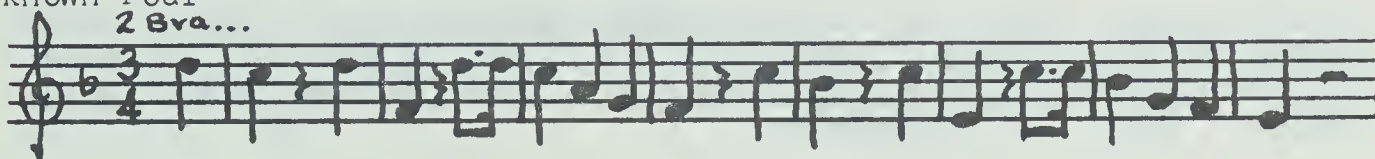
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Unknown Three

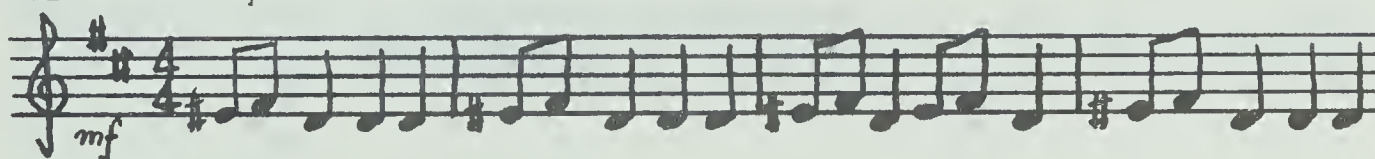


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II - DYNAMICS DISTORTION

Familiar Melody



Unknown One



Unknown Two



Unknown Three

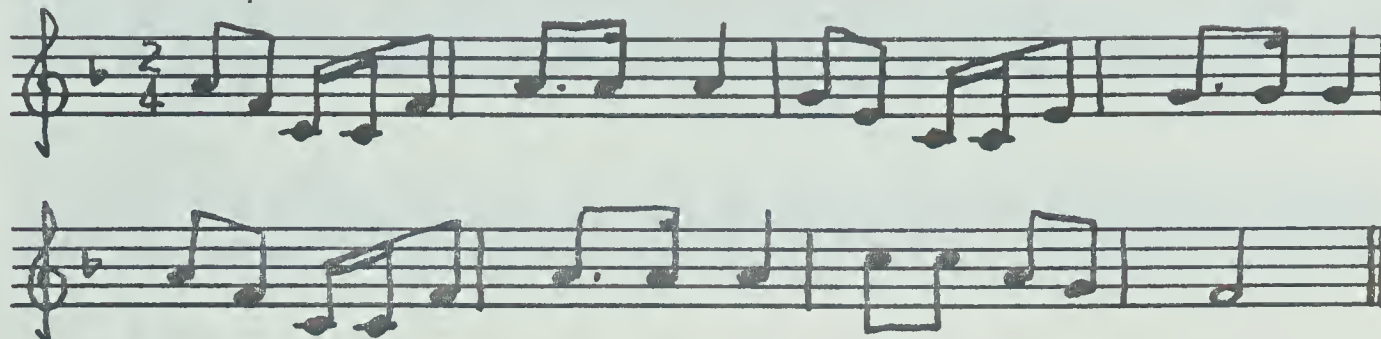


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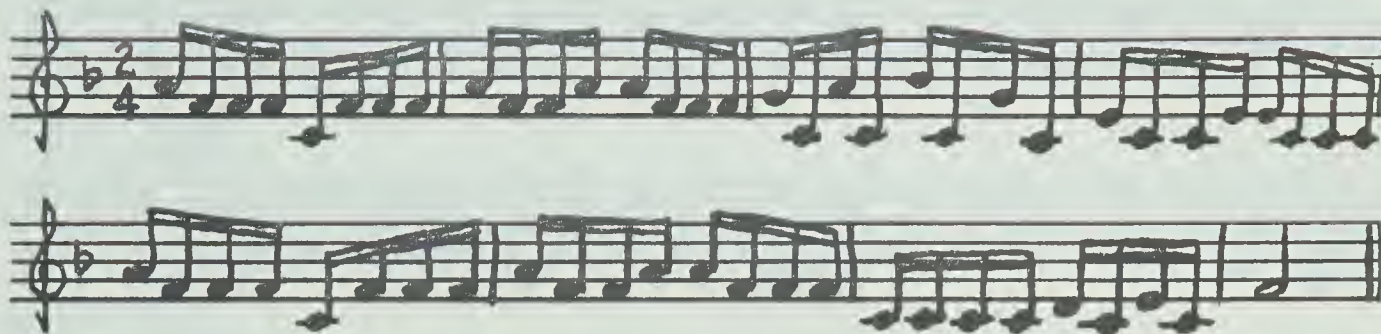


III - TONAL CONFIGURATION HIDDEN

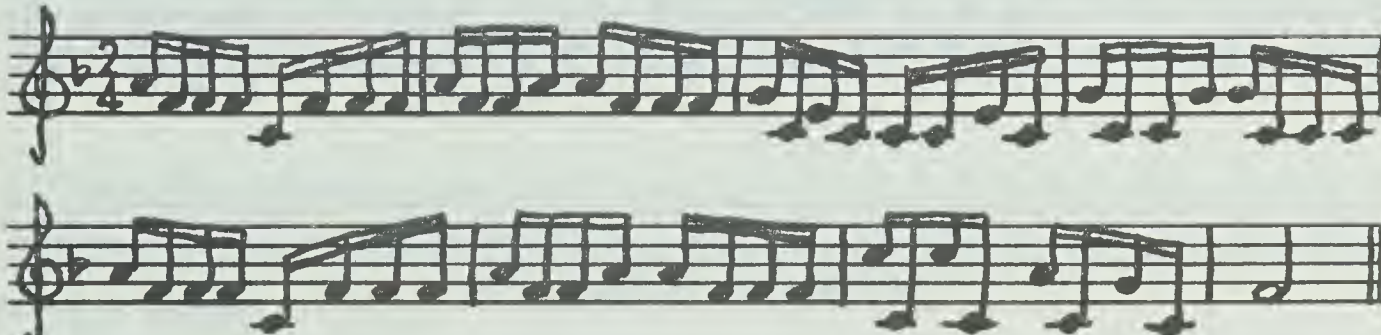
Familiar Melody



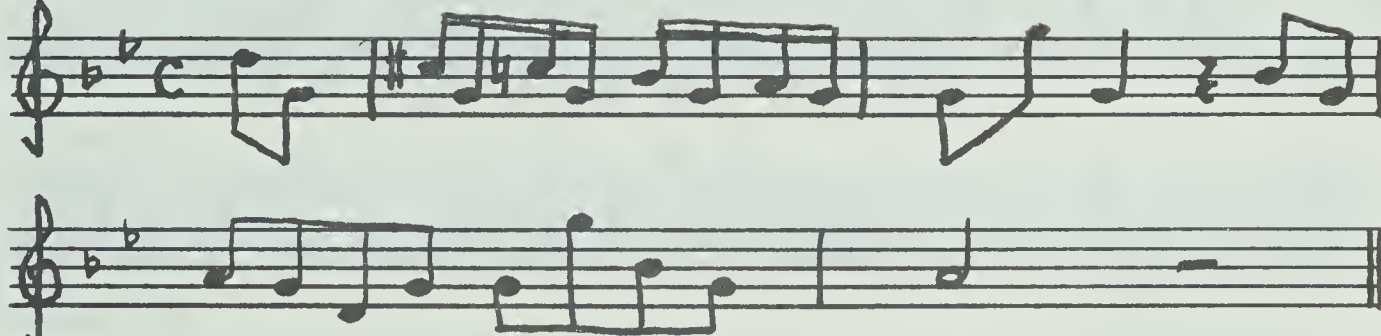
Unknown One



Unknown Two



Unknown Three



Unknown Four



IV - TEMPO DISTORTION

Familiar Melody

$\text{♩} = 96$



Unknown One

$\text{♩} = 192$



Unknown Two

$\text{♩} = 192$



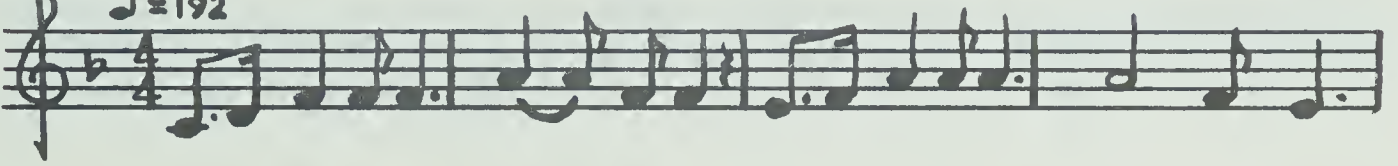
Unknown Three

$\text{♩} = 192$



Unknown Four

$\text{♩} = 192$

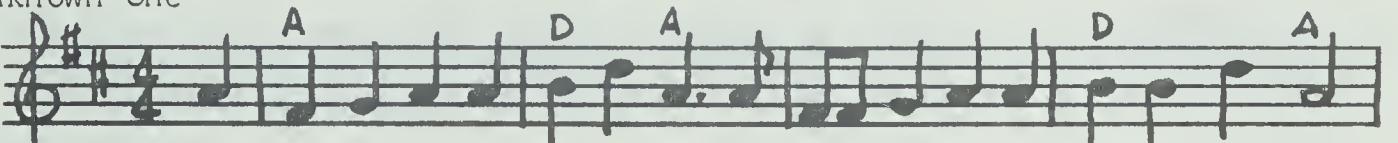


V - HARMONY DISTORTION

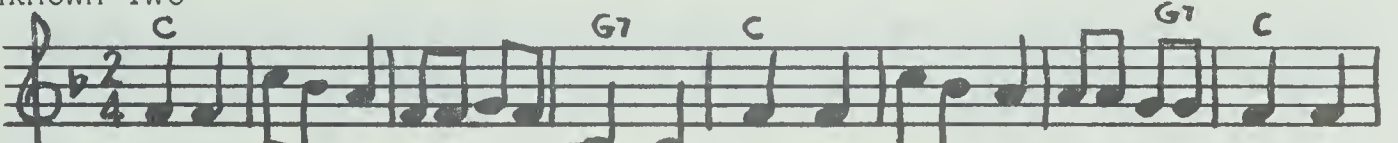
Familiar Melody



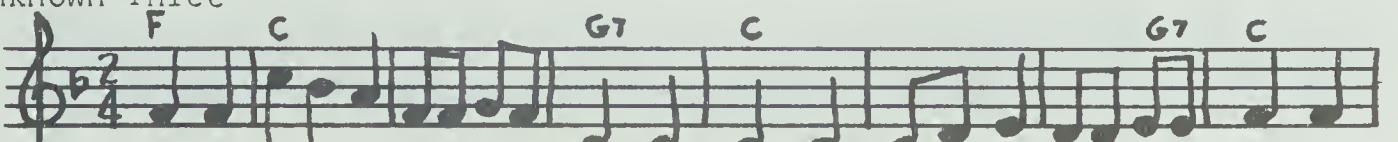
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Unknown Three

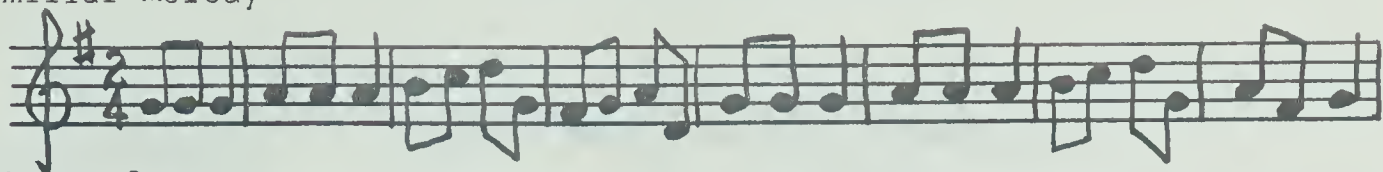


Unknown Four



VI - METER DISTORTION

Familiar Melody



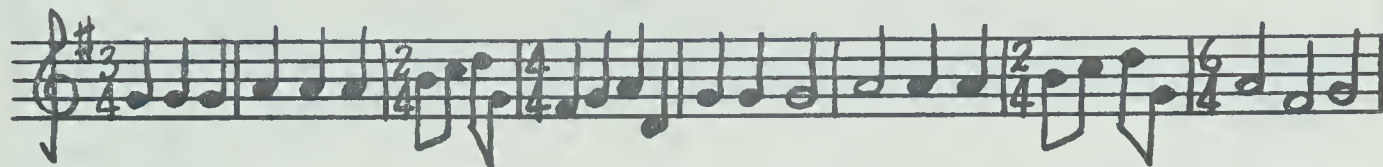
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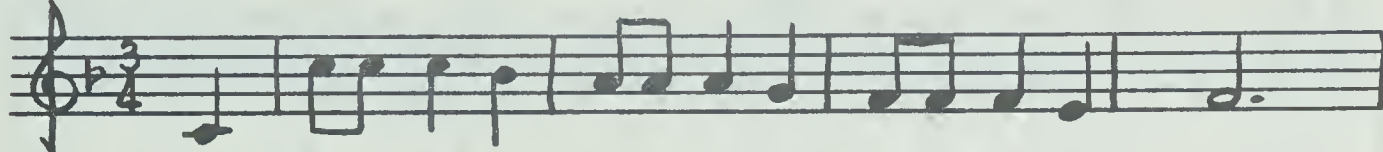
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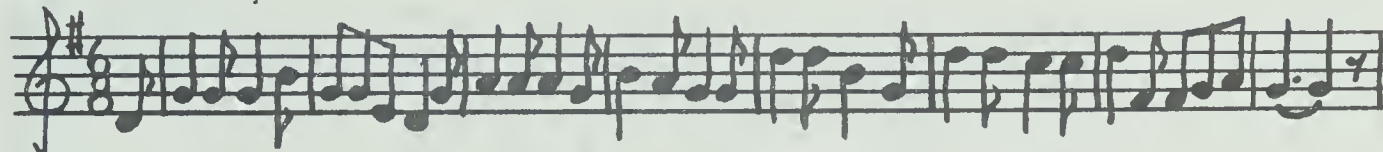


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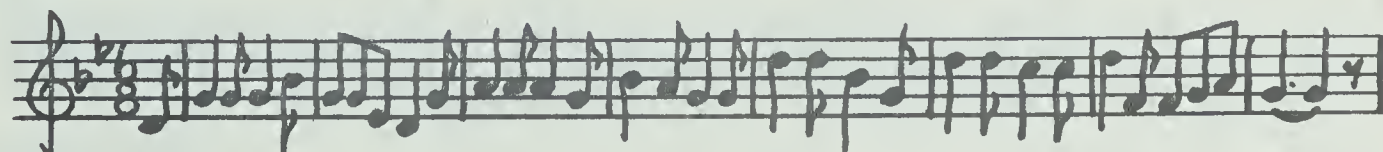


VII - MODE DISTORTION

Familiar Melody



Unknown One



Unknown Two



Unknown Three



Unknown Four



Familiar Melody

VIII - MELODY HIDDEN IN BASS



Unknown One



Unknown Two



Unknown Three



Unknown Four



IX - MELODY TRANSPOSED

Familiar Melody



Unknown One



Unknown Two



Unknown Three



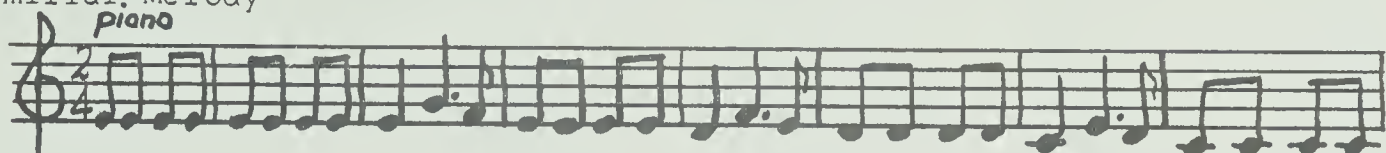
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X - INSTRUMENTATION DISTORTION

Familiar Melody

piano



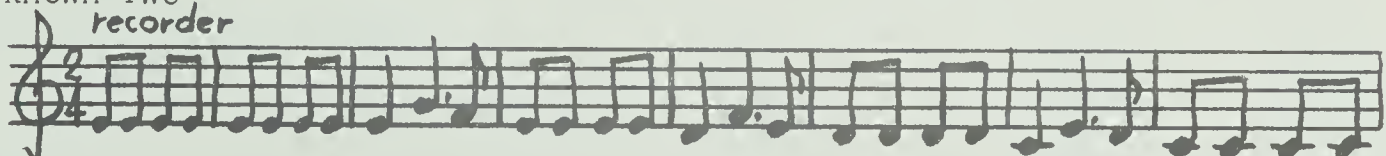
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recorder



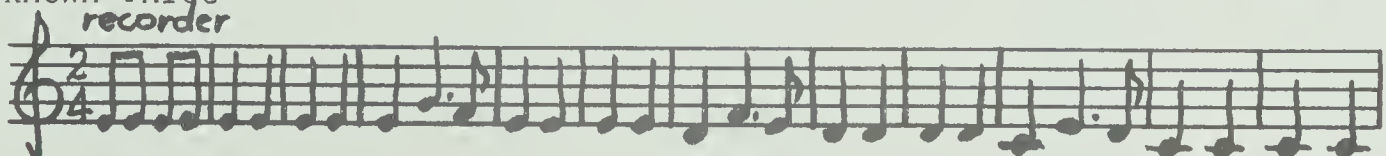
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recorder



Unknown Three

recorder



Unknown Four

recorder



APPENDIX D

ANALYSIS OF VARIABLES IN TERMS OF RANGES,
MEANS, AND STANDARD DEVIATIONS

	Range	Mean	S. D.
Conservation of melody scores	4 - 10	7.13	1.43
Conservers of quantity	0 - 1	0.45	0.50
Conservers of number < 10	0 - 1	0.39	0.49
Conservers of number > 10	0 - 1	0.49	0.50
Conservers of length	0 - 1	0.51	0.50
Conservers of area	0 - 1	0.51	0.50
I.Q.	83 - 140	113.95	11.97
Sex - male	0 - 1	0.49	0.50
Sex - female	0 - 1	0.51	0.50
Age in months	90 - 116	97.85	4.73
Socio-economic status	26.57 - 74.27	42.92	12.94
Conservation Test items - 1	0 - 1	0.45	0.50
2	0 - 1	0.40	0.49
3	0 - 1	0.48	0.50
4	0 - 1	0.53	0.50
5	0 - 1	0.51	0.50
Conservation Scores	0 - 5	2.34	1.32
Conservation of Melody			
Test items - 1	0 - 1	0.91	0.28
2	0 - 1	0.95	0.22
3	0 - 1	0.29	0.46
4	0 - 1	0.93	0.27
5	0 - 1	0.85	0.36
6	0 - 1	0.41	0.50
7	0 - 1	0.78	0.42
8	0 - 1	0.36	0.48
9	0 - 1	0.79	0.41
10	0 - 1	0.86	0.35

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